FINAL RESTORATION PLAN AND ENVIRONMENTAL ASSESSMENT

For the November 26, 2004, M/T *Athos I* Oil Spill on the Delaware River near the Citgo Refinery in Paulsboro, New Jersey.

September 2009

National Oceanic and Atmospheric Administration
U.S. Fish and Wildlife Service
New Jersey Department of Environmental Protection
Delaware Department of Natural Resources and Environmental Control
Pennsylvania Department of Conservation and Natural Resources, Department of Environmental Protection, Fish and Boat Commission, Game Commission

This Final Restoration Plan/Environmental Assessment was prepared by the natural resource Trustee agencies: the National Oceanic and Atmospheric Administration; U.S. Fish and Wildlife Service; New Jersey Department of Environmental Protection; Delaware Department of Natural Resources and Environmental Control; and Pennsylvania Department of Conservation and Natural Resources, Department of Environmental Protection, Fish and Boat Commission, and Game Commission. These agencies have conducted a natural resource damage assessment (NRDA) for the 26 November 2004, spill of more than 263,000 gallons of oil from the M/T *Athos I* into the Delaware River and nearby tributaries. The goal of the NRDA is to restore the public's natural resources injured by the oil spill. This document also serves as an Environmental Assessment to analyze the potential effects of the actions and projects on the quality of the human environment, in accordance with the National Environmental Policy Act.

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Executive Summary

On 26 November 2004, the M/T *Athos I* (*Athos*) struck a large, submerged anchor while preparing to dock at a refinery in Paulsboro, New Jersey. The anchor punctured the vessel's bottom, resulting in the discharge of more than 263,000 gallons of crude oil into the Delaware River and nearby tributaries.

Under the federal Oil Pollution Act (OPA), two federal government agencies—the National Oceanic and Atmospheric Administration (NOAA) and U.S. Fish and Wildlife Service (USFWS)—and the three affected states—New Jersey, Pennsylvania, and Delaware—are responsible for restoring natural resources injured by the *Athos* spill. Under OPA, funding will be made available through the responsible party (RP) or, where an RP does not exist or exceeds its limit of liability, the Oil Spill Liability Trust Fund (OSLTF) administered by the U.S. Coast Guard (USCG).

The two federal agencies and the three affected states, acting as Trustees on the public's behalf, have conducted a natural resource damage assessment (NRDA) to determine the nature and extent of natural resource losses resulting from this incident and the restoration actions needed to restore these losses. The NRDA was conducted using the OPA NRDA regulations.

This final Restoration Plan/Environmental Assessment (final Plan) was prepared by the *Athos* Trustees to inform the public about the NRDA and restoration to be conducted by the Trustees.

What was injured?

Injury assessments conducted by the Trustees and other experts identified the following injuries to natural resources and recreational services from the spill:

- Shoreline – 1,729 acres were very lightly, lightly, moderately, or heavily oiled.
- Tributaries – Six tributaries, with a total area of 1,899 acres, were exposed to very light to moderate oiling.
- Aquatic – 412 acres were exposed to *Athos* oil.
- Birds – 11,869 estimated dead (includes direct and indirect losses, a majority of which were swans and geese).
- Recreational services – An estimated 41,709 trips on the river were affected by the spill, with an estimated lost value of $1,319,097.

How were restoration alternatives evaluated and identified as preferred projects?

The Trustees considered numerous restoration alternatives to compensate the public for spill-related injuries. Each proposed project was evaluated using criteria in the OPA NRDA regulations, in addition to site-specific criteria developed by the Trustees for this incident. Consideration of an appropriate range of alternatives also addressed National Environmental Policy Act (NEPA) requirements. Once the draft DARP/EA was vetted through a public comment process, and those comments addressed, this final Plan was developed.

After evaluating the proposals, the Trustees identified the following preferred restoration projects:

Freshwater tidal wetlands restoration at John Heinz National Wildlife Refuge (Pa.)
Restore 7.0 acres of freshwater tidal wetland to benefit 56 acres within John Heinz National Wildlife Refuge to compensate for tributary losses. This project would restore tidal exchange to the proposed site through tidal channels, shallow pools, and scrub/shrub wetland habitat.

Create oyster reefs (N.J., Del.)
Create roughly 78 acres of oyster reef in the Delaware River to compensate for injuries to aquatic resources, diving birds, and gulls. Oyster reefs enhance benthic communities, increase aquatic food for fish and birds, and improve water quality by filtering out sediments and pollutants from the water column.

Darby Creek dam removal and habitat restoration (Pa.)
Remove three dams and a remnant bridge pier from Darby Creek in southeastern Pennsylvania to open up an additional 2.6 miles of habitat to anadromous fish, and restore about 10 acres of riparian habitat along the creek edges. Dam removal and riparian habitat projects would compensate for tributary losses.

Habitat restoration at Mad Horse Creek (N.J.)
Restore 59.6 acres of degraded wetland and create 35 acres of wet meadow and 100 acres of grassland at state-owned property on Mad Horse Creek (N.J.). The wetland restoration would compensate for non-tributary shoreline losses and a portion of the bird loss. The increase in upland vegetation (wet meadow and grassland habitat) would serve as food sources that can reasonably be expected to enhance bird biomass, thereby compensating for a portion of the total bird loss.

Shoreline restoration at Lardner's Point (Pa.)
Restore shoreline through the demolition of existing structures, import of fill material, grading of a 0.9 acre site to restore tidal inundation, and creation of intertidal marsh and wet meadow habitat. This shoreline restoration project would have multiple benefits in the urban part of the river that was heavily impacted by the spill.

Blackbird Reserve Wildlife Area Pond and Pasture Enhancement (Del.)
Excavate two shallow wetland ponds in former agricultural areas, convert 16 acres of agricultural lands to cool-season grass pasture, and establish approximately 24 acres of food plots by modifying existing agricultural practices. Conversion of existing agricultural land to pond and pasture habitat and modification of existing agricultural practices would provide resting and foraging areas targeted to migratory geese.

Improve recreational opportunities (Pa., N.J., Del.)
Implement three projects to address the estimated 41,709 river trips that were affected by the spill:

- Improve the Stow Creek (N.J.) boat ramp;
- Construct an additional breakwater at Augustine Boat Ramp (Del.) to address ongoing shoaling immediately offshore of the boat ramp; and
- Enhance the recreational trail on Little Tinicum Island (Pa.).

Who will fund implementation of the restoration projects?

The U.S. Coast Guard (USCG) has determined that the RP has exceeded its limit of liability under the Oil Pollution Act (USCG 2005a). Therefore, the final Plan will be submitted to the Oil Spill Liability Trust Fund (OSLTF) as part of a claim for funds to implement the preferred restoration projects. The OSLTF is administered by the USCG. It was established and is primarily maintained by a five cent per barrel tax from the oil industry on oil produced in or imported to the U.S.

CHAPTER 1.0 - Introduction

1.1 - Overview of the Incident

The *Athos* departed Venezuela, South America, for the Citgo Asphalt Refinery in Paulsboro, N.J., on 26 November 2004, carrying approximately 13 million gallons of Bachaquero Venezuelan crude oil. The single-bottom, double-sided vessel was registered under the flag of Cyprus, owned by Frescati Shipping Company, Ltd., and operated by Tsakos Shipping & Trading, S.A., who was designated as the Responsible Party (RP).

At approximately 9:30 p.m. on 26 November 2004, tug operators assisting the *Athos* with docking at the refinery notified the U.S. Coast Guard (USCG) that the tanker was leaking oil. The vessel had struck several submerged objects while maneuvering through Anchorage #9 to its berth (Figure 1). Within minutes, the ship lost power and listed approximately 8 degrees to the vessel's port side (USCG 2005b) (Figure 2).

Surveys of the river bottom following the incident found several objects in the area, including an 18,000-pound anchor, large concrete block, and pump casing (Figure 3). USCG determined that the anchor punctured the vessel's number seven center cargo and port ballast tanks (USCG 2006). The bulkhead between the cargo and ballast tanks was also damaged, allowing oil to migrate into the ballast tank and then into the river (USCG 2005b).

Initial reports indicated that the vessel released 30,000 gallons of the heavy crude oil. Later reports on 30 November suggested an increase in the volume spilled to a maximum potential of 473,500 gallons. The final estimate of 263,371 gallons became known after lightering of the remaining oil from the vessel and comprehensive analysis (USCG 2006).

At the time of the release, the tide was incoming, and the current was approximately 1-1/2 to 2 knots (USCG 2005b). Within the first few hours, thick oil covered the Delaware River and moved upriver with the flood tide to the vicinity of the Walt Whitman Bridge, approximately 6 miles north (Figure 1). Over the following weeks and months, oil from the ruptured tanker spread downriver, threatening natural resources over 115 river miles (280 miles of shoreline), as well as its tributaries (Figure 4), from the Tacony-Palmyra Bridge to south of the Smyrna River in Delaware. The incident also forced USCG to close the River to commercial traffic for over a week.

Figure 1. Approximate location of the *Athos* incident on the Delaware River. East of the river, Camden, Gloucester, and Salem Counties are in New Jersey. West of the river, Philadelphia and Delaware Counties are in Pennsylvania; New Castle County is in Delaware.

Figure 2. Aerial view of the *Athos* listing to its port side following the grounding incident.

Figure 3. Submerged objects recovered from the *Athos* grounding location.

a. b.

c. d.

Figure 4. Key resources exposed to *Athos* oil. a. Heavy oil stranded in the intertidal area, south side of Little Tinicum Island; b. Heavily oiled rip-rap shoreline at Fort Mifflin, near Philadelphia; c. Heavily oiled coarse substrate beach; and d. Oiled waterfowl.

Federal, state, and local agencies responded to the incident to supervise and assist in cleanup and begin to assess the impact of the spill on natural resources. The USCG and states of New Jersey, Delaware, and Pennsylvania created a Unified Command for directing cleanup efforts. The National Oceanic and Atmospheric Administration (NOAA), U.S. Fish and Wildlife Service (USFWS), natural resource agencies within Delaware, New Jersey, and Pennsylvania (collectively referred to as the natural resource Trustees), and the RP began collecting "preassessment" data to determine whether natural resource damage assessment (NRDA) actions under the Oil Pollution Act of 1990 (OPA) (33 U.S.C. §2706(b)) were justified. With the preassessment data, involved agencies made preliminary determinations regarding the type of injury assessment and restoration actions that might be pursued.

Cleanup activities ended on 22 April 2005, when the USCG reported that 221,910 gallons of oil and oily liquid had been recovered and 17,761 tons of oily solids (cleanup material and oil) had been collected. Damage assessment concluded in 2007, while restoration planning is continuing into 2009.

1.2 - Summary of Preassessment Activities

Under OPA, state and federal agencies are designated as natural resource Trustees, responsible for assessing natural resource losses and restoring those losses to baseline conditions (i.e., the conditions that would have existed had the incident not occurred). Regulations promulgated under OPA provide a framework for conducting a NRDA, including preassessment, restoration planning, and restoration implementation (15 C.F.R. Part 990). Funds to assess losses and to plan and implement appropriate restoration are provided by either the RP or, if an RP does not exist or exceeds its limit of liability, the OSLTF[1] established under OPA.[2]

The *Athos* Trustees and RP initiated preassessment activities on 27 November 2004, immediately following notification of the incident. These efforts included shoreline (aerial and ground) and resource (i.e., birds and wildlife, horseshoe crab) surveys and collection of ephemeral data, including water, sediment, and fish and shellfish tissue samples.

Preassessment data collection efforts and findings are detailed in the Trustees' Preassessment Data Report (NOAA 2006). As summarized in Chapter 4 of this final Plan, preassessment activities provided evidence of injury or potential injury to shoreline, aquatic, bird, wildlife, and recreation resources, and supported the Trustees' decision to initiate a NRDA pursuant to Section 1006 of OPA.

[1] The OSLTF is administered by the USCG. It was established and is maintained by the collection of a tax on the petroleum industry. See the NPFC's Web site (www.uscg.mil/npfc).

[2] Under OPA, the limits of liability are based on the vessel's gross tonnage (GT). The gross tonnage of the *Athos* is 37,895 GT. Accordingly, the limit of liability is $45,474,000 ($1,200 per GT) (USCG 2005b). Following the *Athos* incident, the Delaware River Protection Act of 2006, amended (i.e., increased) the limits of liability under OPA. See the NPFC's Web site (www.uscg.mil/npfc) for current applicable limits.

The Trustees' NRDA focused on determining the nature and extent of natural resource losses. An overview of each injury assessment is presented in Chapter 4 of this final Plan; Table 1 summarizes the findings.

1.3 - Summary of Injury Assessment

Injuries to natural and recreational resources were assessed by the Trustees beginning shortly after the spill. Natural resource injuries were divided into three main categories: shoreline, aquatic, and bird and wildlife resources. Shoreline injury comprised seawalls, sand/mud substrate, marsh, and coarse substrates which affected approximately 1,729 acres. Shorelines also encompassed tributaries which affected nearly 1,900 acres. Aquatic injury applied to subtidal benthic habitat and affected 412 acres. The bird and wildlife category covered injuries to dabbling ducks, diving ducks, diving birds, gulls, shorebirds, wading birds, swans/geese, and kingfishers. 11,869 adult and fledged young birds were injured as a result of the *Athos* spill. Recreational resources affected by the spill were lost and diminished trips and were estimated to be 41,709 trips valued at $1,319,097.

1.4 - Summary of Alternatives Analysis and Identification of Preferred Restoration Projects

Restoration actions under OPA are termed primary or compensatory. Primary restoration accelerates the return of injured natural resources and services to baseline conditions. Trustees may elect to rely on natural recovery rather than primary restoration actions where feasible or when cost-effective primary restoration actions are not available, or where the injured resources would recover relatively quickly without human intervention. Compensatory restoration is any action taken to compensate for interim losses of natural resources and services pending recovery. The scale of the required compensatory restoration depends on the extent and severity of the initial resource injury and how quickly each resource and associated service returns to baseline. Primary restoration actions that speed resource recovery will reduce the requirement for compensatory restoration.

Based on observations made during the injury assessment and the best professional judgment of the scientific experts retained for those studies, the Trustees determined that active primary restoration would not significantly speed the recovery to baseline levels. Therefore, the natural recovery alternative was chosen for primary restoration.

The Trustees identified and evaluated a wide range of project alternatives capable of compensating the public for injuries resulting from the *Athos* oil spill incident. Restoration ideas and alternatives were evaluated, with the preferred restoration projects scaled to ensure that their size appropriately compensates for the injuries resulting from the spill. Chapter 5 of this final Plan presents OPA-based selection criteria developed by the Trustees for this spill and how these criteria were applied to identify the reasonable alternatives for compensatory restoration, referred to as the "action alternatives" for purposes of NEPA. Chapter 5 provides the evaluation and comparison of action alternatives that led to the Trustees' identification of the nine preferred projects to meet the purpose and need for action. In addition, as required by NEPA regulations, Chapter 5 presents the "No Action" alternative in which no restoration would be conducted.

Based on the Trustees' evaluation of potential restoration projects and consideration of comments received on the draft DARP/EA, the preferred action consists of the implementation of all nine projects. These projects are described in Chapter 5. Table 1 presents each of the Trustees' preferred compensatory restoration projects and the compensatory loss that each is scaled to restore.

Table 1. Summary of injuries resulting from the *Athos* incident and preferred restoration projects. ***Project costs do not include contingency costs.***						
Resource Category		**Injury**	**Primary Restoration**	**Preferred Compensatory Restoration Project**		**Project Cost**
Aquatic	subtidal benthic habitat	412 acres	Natural Recovery	4.5 acres	Oyster reef enhancement and restoration (Del. and N.J.)	$703,490
Bird and Wildlife	gulls	2,946 birds (direct and indirect)	Natural Recovery	73.5 acres		
	diving ducks, diving birds, wading birds, kingfishers	464 birds (direct and indirect)				
	dabbling ducks and shorebirds	2,503 birds (direct and indirect)	Natural Recovery	25.4 acres	Mad Horse Creek (N.J.) marsh restoration	$12,390,945
	swans and geese	5,956 birds (direct and indirect)	Natural Recovery	35 acres	Mad Horse Creek (N.J.) wet meadow	
				100 acres	Mad Horse Creek (N.J.) grassland restoration	
				41.8 acres	Blackbird Reserve Wildlife Area pond and pasture enhancement (Del.)	$104,891
Shoreline	seawalls, sand/mud substrate, marsh, coarse substrate	1,729 acres	Natural Recovery	34.2 acres	Mad Horse Creek (N.J.) marsh restoration	$7,016,065
				0.9 acre	Lardner's Point (Pa.) shoreline restoration	$643,271
	tributaries	1,899 acres	Natural Recovery	56 acres	John Heinz (Pa.) habitat restoration	$2,968,517
				2.6 miles	Darby Creek (Pa.) dam and remnant bridge pier removal and habitat restoration	$1,328,194
Recreation	Trips affected (lost and diminished value)	41,709 trips	Natural Recovery	$466,536	Stow Creek (N.J.) boat ramp improvements	$1,319,097
				$818,687	Augustine (Del.) boat ramp breakwater installation	
				$33,874	Little Tinicum Island (Pa.) trail and habitat improvements	
					TOTAL	**$26,474,470**

CHAPTER 2.0 - Purpose and Need for Restoration

The purpose of the preferred actions is to restore natural resources injured, lost, or destroyed within and in habitats adjacent to the Delaware River in Philadelphia and Delaware counties, Pennsylvania, New Castle and Kent counties, Delaware, and Salem and Cumberland counties, New Jersey, due to the discharge of oil on 24 November, 2004. The need to pursue such actions is based upon the implementing regulations of OPA which establish liability for the injury to, destruction of, or loss of natural resources caused by discharges of oil. Damages recovered for these losses must be used to restore, replace, rehabilitate, or acquire equivalent natural resources or services, in accordance with a restoration plan developed by designated natural resource trustees.

2.1 - Authorities and Legal Requirements for NRDA Under OPA

The natural resource Trustees for this oil spill include two federal agencies and three states: NOAA, the primary federal Trustee for coastal and marine resources; the U.S. Fish and Wildlife Service (USFWS), the primary federal Trustee for migratory birds, some fish, many endangered species, and lands managed by the agency; and the states of New Jersey, Delaware, and Pennsylvania, which have responsibilities for natural resources and their supporting ecosystems belonging to, managed by, controlled by, or appertaining to their respective state. These agencies are designated as Trustees pursuant to OPA (33 U.S.C. §2706(b)) and the National Oil and Hazardous Substances Pollution Contingency Plan (40 C.F.R. §§300.600 et seq.). The Trustees also have complied with key federal statutes, regulations, and policies which can be found in Appendix 3. As a designated Trustee, each is authorized to act on behalf of the public to protect and restore natural resources that have been injured by a discharge or substantial threat of oil.

2.1.1 - Overview of the Oil Pollution Act

OPA provides the statutory authority for natural resource Trustees to assess and restore injuries resulting from oil spill incidents. OPA, codified at 15 CFR Part 990, defines injury as “an observable or measurable adverse change in a natural resource or impairment of a natural resource service.” Restoration, under the OPA regulations, means “restoring, rehabilitating, replacing, or acquiring the equivalent of injured natural resources and services” and includes both primary restoration conditions and compensatory restoration.

A NRDA, as described under Section 1006 of OPA (33 U.S.C. §2706), and its implementing regulations (15 C.F.R. 990), consists of three phases: (1) preassessment; (2) restoration planning; and (3) restoration implementation. The Trustees may initiate a damage assessment provided that an incident has occurred; the incident is not from a public vessel or an onshore facility subject to the Trans-Alaska Pipeline Authority Act; the incident is not permitted under federal, state or local law; and Trustee natural resources may have been injured as a result of the incident.

Based on information collected during the preassessment phase, the Trustees make an initial determination as to whether natural resources or services have been injured, or are likely to be injured, by the release. Through coordination with response agencies (e.g., the USCG for the

Athos incident), the Trustees next determine whether the oil spill response actions will eliminate the injury or the threat of injury to natural resources. If injuries are expected to continue, and feasible restoration alternatives exist to address such injuries, the Trustees may proceed with the restoration planning phase. Even if degradation from injuries is not expected to continue, restoration planning may be necessary if injuries resulted in interim losses requiring compensatory restoration.

The purpose of the restoration planning phase is to evaluate the potential injuries to natural resources and services, and to use that information to determine the need for, type of, and scale of restoration actions. OPA defines natural resources as: "land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States, any state or local government or Indian tribe, or any foreign government (33 U.S.C. 2701(20))." Services (or natural resource services) are functions performed by a natural resource for the benefit of another natural resource and/or the public.

Restoration planning under OPA has two components: injury assessment and restoration selection. The goal of injury assessment is to determine the nature and extent of injuries to natural resources and services, thus providing a factual basis for evaluating the need for, type of, and scale of restoration actions. Restoration selection involves identifying a reasonable range of restoration alternatives; evaluating and selecting the preferred alternative(s); developing a draft Restoration Plan/Environmental Assessment (EA); presenting the alternative(s) to the public; soliciting public comment on the draft Restoration Plan/EA; and considering those comments before issuing a final Restoration Plan/EA.

During the restoration implementation phase, the final Restoration Plan is presented to the RPs to implement or to fund the Trustees' cost of implementing the Plan, thus providing an opportunity for settlement of damage claims without litigation. Should the RPs decline to settle a claim, OPA authorizes Trustees to bring a civil action against RPs for damages. If a viable RP does not exist, or where an RP has exceeded its limit of liability, Trustees can seek damages from the OSLTF for the assessment and restoration costs. Components of damages are specified in sections 1002(b) and 1001(5) of OPA and include the cost of conducting damage assessments.

2.1.1.1 - Coordination among the Trustees

Throughout the damage assessment process (i.e., preassessment and restoration planning) for the *Athos* incident, the federal and state Trustee agencies worked together to meet their respective natural resource Trustee responsibilities under OPA and other applicable federal law, as well as state statutory and common law. A Memorandum of Agreement (MOA) signed by all of the Trustees provided a framework for coordination by establishing a Trustee Council responsible for all NRDA activities. The Trustee Council met on a regular basis, with NOAA serving as the Federal Lead Administrative Trustee (LAT) and the overall NRDA coordinator at the request of the other Trustees. All injury assessment and restoration planning decisions were made by a consensus of Trustee Council representatives.

2.1.1.2 - Coordination with the Responsible Parties

The OPA regulations require the Trustees to invite the RPs to participate in the damage assessment process (16 USC 990.44). Accordingly, the Trustees and the RP initiated cooperative assessment activities immediately following the spill. Cooperative work groups were formed, consisting of Trustees and the RP, to assist with the design of studies and interpretation of data. The Trustee Council also met periodically with the RP to review aspects of the NRDA.

To formalize the cooperative assessment, the Trustees and the RP initiated discussions on an MOA outlining the terms of the cooperative assessment. The Trustees also sent a letter to the RP[3] inviting their participation in a formal cooperative assessment, and requesting agreement to pay reasonable assessment costs incurred by the Trustees, consistent with OPA. The RP responded on 24 May 2005[4], accepting the Trustees' invitation to participate in a cooperative assessment, but declining to pay the Trustees' assessment costs, based on their belief that they were entitled to a limitation of liability pursuant to Section 1004(a) of OPA, and possibly exoneration, pursuant to Section 1003(a)(3) of OPA. Based on this response, and because a determination regarding a limit of liability and/or exoneration had not been made, the Trustees determined that it would not be appropriate to continue with a formal cooperative assessment[5] and ended discussions with the RP about the MOA. The Trustee technical working groups (TWGs)[6] did, however, continue to meet jointly with the RP to share and discuss information collected. While this coordination between the Trustees and the RP reduced duplication of studies, increased the cost-effectiveness of the assessment process, and increased sharing of information and expertise, the final authority to make determinations regarding injury and restoration rested solely with the Trustees.

2.1.1.3 - Coordination with the Public

Throughout the NRDA process, the Trustees have provided the public with information on the status of injury assessment and restoration planning efforts. The Trustees published a Notice of Intent to Conduct Restoration Planning in the *Federal Register* (Vol. 71, No. 127, pgs. 37908 – 37910: 3 July 2006) stating that, based on preassessment findings, they were proceeding with restoration planning under OPA and opening an Administrative Record (AR) to facilitate public involvement in the restoration planning process. The Trustees also placed information about the spill on their Internet sites, including an electronic copy of the AR on the NOAA Web site (http://www.darrp.noaa.gov/northeast/athos/index.html). Through the above-mentioned efforts, the public was able to obtain reports, injury assessment studies, and agency contacts to obtain more information.

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[3] http://www.darrp.noaa.gov/northeast/athos/pdf/Sharon_Shutler_letter_dated_03.09.05.pdf
[4] http://www.darrp.noaa.gov/northeast/athos/pdf/Timothy_Bergere_letter_dated_05.24.05.pdf
[5] http://www.darrp.noaa.gov/northeast/athos/pdf/Sharon_Shutler_letter_dated_06.21.05.pdf
[6] Technical working groups (TWGs) were formed for each major injury category, e.g., marsh destroyed, birds killed, recreational use denied, and were responsible for the assessment of that particular injury. TWGs were formed from members of each trustee agency that had injured resources of concern, and may have included a representative of the Responsible Party.

The Trustees submitted the draft Plan for public review and comment on January 6, 2009. Public review of the draft Plan was an integral component of the restoration planning process. Through the process of public review, the Trustees sought public comment on the projects that were proposed to restore injured natural resources or replace services provided by those resources.

While preparing the final Restoration Plan, the Trustees reviewed and considered comments received during the public comment period. Public review of the draft Damage Assessment and Restoration Plan and Environmental Assessment was consistent with all state and federal laws and regulations that apply to the natural resource damage assessment process, including Section 1006 of OPA, the regulations for Natural Resource Damage Assessment under OPA (15 CFR Part 990), NEPA (42 USC Section 4371, et seq.), and the regulations implementing NEPA (40 CFR Part 1500, et seq.). In reponse to changes in baseline injury calculations, the preferred Mad Horse marsh project was reduced by approximately 4 acres, which is not a significant change in the project.

Comments received during the public comment period were considered by the Trustees before completing this final Plan. The Trustees' responses to these comments are included as Appendix 1 of this final Plan.

2.1.1.4 - Administrative Record

The administrative record contains documents considered and/or prepared by the Trustees as they have planned and implemented the NRDA and addressed restoration and compensation issues and decisions. The administrative record is now available for public review at http://www.darrp.noaa.gov/northeast/athos/admin.html. The record contains the information that the Trustees relied upon to make the decisions described in this final Plan. The administrative record facilitates public participation in the assessment process and will be available for use in future administrative or judicial review of Trustee actions to the extent provided by federal or state law. A list of documents submitted to the administrative record is included in Appendix 2 of this final Plan

A new administrative record will be opened upon payment of the claim for funds to implement this final Plan. The location and contact of the Restoration Implementation Administrative Record will be:

Bethany M. Bearmore, P.E.
NOAA Restoration Center
James J. Howard Marine Fisheries Laboratory
74 Magruder Road
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Hard copies of the documents within the administrative record may be obtained by contacting the individual listed above. Documents will be made available to disabled readers.

2.1.2 - NEPA Compliance

Restoration of natural resources under OPA must comply with NEPA (42 U.S.C. §4371 et seq.) and its implementing regulations (40 C.F.R. 1500 et seq.). In compliance with NEPA, this final Plan also serves as an Environmental Assessment (EA). As such, it includes a summary of the current environmental setting, describes the purpose and need for action, and identifies alternative actions and their potential environmental consequences.

The Trustees used information contained in the draft Plan to make a threshold determination as to whether preparation of an Environmental Impact Statement (EIS) was required prior to the selection of the final preferred restoration actions (i.e., whether the action is a major federal action that may significantly affect the quality of the human environment).

CHAPTER 3.0 - Affected Environment

This chapter briefly describes the physical, biological, economic, and cultural environment within which restoration actions might occur. The affected environment for restoration follows the Delaware River and the lower reaches of its tributaries, extending from the Tacony-Palmyra Bridge near Philadelphia, Pennsylvania, to the Bombay National Wildlife Refuge, near Dover, Delaware—a total distance of approximately 115 river miles (280 miles of shoreline). This area contains many tidal tributaries, marshes, and shoreline habitats, as well as the river bed itself. The biological environment includes a wide variety of fish, birds, mammals, and other organisms, including the endangered shortnose sturgeon (*Acipenser brevirostrum*) (NOAA 2005; USFWS 2006). The economic and cultural environment includes shipping and port activities, as well as fishing and other recreational uses of the River. Additional detail regarding the affected environment also is presented in Chapter 4 of this final RP/EA, as an understanding of the environment affected by a spill is integral to conducting an injury determination and evaluating potential restoration projects.

3.1 - Physical Environment

The Delaware River extends approximately 330 miles from Hancock, New York, to the mouth of the Delaware Bay, and includes 216 tributaries (DRBC 2005). In the vicinity of the spill, the Delaware River separates Pennsylvania and New Jersey in the north and Delaware and New Jersey in the south. The physical environment of the Delaware River and its environs is impacted greatly by human development, including draining and filling of wetlands. Perhaps 50 percent of the natural marshes in the estuary have been lost to development, conversion, or degradation associated with human activities. Losses have been most severe in the urban corridor where perhaps only 5 percent of pre-settlement acreage of the nationally rare freshwater tidal marsh remains. In addition, there are many natural threats to the wetlands ecosystem such as subsidence (including the rise of sea level), droughts, hurricanes, and biotic effects (Tiner and Burke 1995). Although there are some natural areas nearby, the area immediately surrounding the spill is heavily industrialized with commercial enterprises and marinas scattered along the shoreline (USCG 2005b). The industrial shoreline is mostly rip-rap and seawall (USCG 2005b).

Three reaches located north of the *Athos* spill site are included in the National Wild and Scenic Rivers System, while the Delaware Bay and the tidal portion of the river lie within the Delaware National Estuary Program (DRBC 2005). Most of the creeks off of the Delaware River have vegetated banks and marshes (USCG 2005b). Tributaries to the Delaware River that support sensitive wetlands include: Mantua Creek, Darby Creek, Raccoon Creek, Oldmans Creek, and Big Timber Creek (USCG 2005b). Chester Island, Little Tinicum Island, and Monds Island support shorelines of freshwater marsh. Many of the wetlands in the area are vegetated intertidal areas (RCG/Hagler, Bailly, Inc. and Environmental Consulting Services, Inc. 1990), along with estuarine emergent wetlands, estuarine intertidal flats, and small areas of palustrine shrub-scrub wetlands (Hess et al. 2000). Wetlands in the area are particularly important to bird species, providing breeding grounds, over-wintering areas, and feeding grounds for migratory waterfowl and numerous other birds.

This stretch of the river is tidally influenced. Salinities of the Delaware River and its tidal creeks vary with distance from the Atlantic Ocean, seasonally, and according to precipitation events. Salinity is zero parts per thousand (ppt) near Philadelphia, and increases downstream to approximately 28-30 ppt at the mouth of the estuary (Hess et al. 2000). Salinities of 10 ppt are normally found adjacent to the C&D Canal (Kraft 1988).

The river bottom is composed mostly of mud along with some clay and fine grained sediments; gravel and sand are found closer to the shoreline (Kraft 1988; Hess et al. 2000). The river and estuary are major depositional areas (Kraft 1988), and regular dredging of the main channel occurs for shipping traffic.

A total of approximately 280 miles of shoreline were exposed to oil during the *Athos* spill, which extended from the Tacony-Palmyra Bridge in northern Philadelphia to the Smyrna River in Delaware, north of Dover. Natural areas affected included: Little Tinicum Island, Supawna Meadows National Wildlife Refuge, Fort Delaware State Park (Pea Patch Island), Fort DuPont State Park, and the Augustine and Cedar Swamp Wildlife Areas in Delaware.

3.2 - Biological Environment

This reach of the Delaware River provides year-round habitat for a host of fish, birds, mammals, and other organisms. However, the upper thirty or so miles of the affected area are highly industrialized, so much natural habitat in this area has been converted to other uses. Farther downstream, below Wilmington, Delaware, are more natural areas including wetlands and tributaries.

3.2.1 - Birds

The Delaware River between Philadelphia and Wilmington lies along the migration route of the Atlantic Flyway. Nesting Great Blue Herons (*Ardea herodias*) are found on Monds Island, and it is an important resting area for migrating songbirds in the spring and fall (Stiles 2005). Pea Patch Island, home of Fort Delaware State Park, contains the largest heron rookery north of Florida and is home to breeding herons, egrets, and ibises (DNREC 2005). There are high concentrations of waterfowl in the marsh areas and tributaries of the river adjacent to the spill, including American Black Ducks (*Anas rubripes*), Canada Geese (*Branta canadensis*), and Northern Pintails (*Anas acuta*) (USCG 2005b).

3.2.2 - Fish

The shortnose sturgeon (*Acipenser brevirostrum*) is a federally endangered species known to use the Delaware River as an over-wintering area (USFWS 2006). Juvenile fish species and larvae such as juvenile American shad (*Alosa sapidissima*) may over-winter in the estuary and Atlantic (*Acipenser oxyrhynchus*) and shortnose sturgeon spend their first year in the estuary (Price et al. 1988). Southern areas of the river affected by the spill are spawning grounds for white perch (*Morone americana*) and striped bass (*Morone saxatilis*) (RCG/Hagler, Bailly, Inc. and Environmental Consulting Services, Inc. 1990). Other species in the river include: American eel

(*Anguilla rostrata*), common carp (*Cyprinus carpio*), striped bass, gizzard shad (*Dorsoma cepadianum*), Atlantic menhaden (*Brevoortia tyrannus*), and catfish.

3.2.3 - Plants

The Pennsylvania Bureau of Forestry contracted with the University of Pennsylvania to carry out an assessment of oil damage to tidal marshes of Little Tinicum Island after the *Athos* incident (Rhoads 2004). Species of special concern found on Little Tinicum Island include wild rice (*Zizania aquatica*), water hemp ragweed (*Amaranthus cannabinus*), and Walter's barnyard grass (*Echinochloa walteri*) (PA DCNRa). Marsh fleabane (*Pluchea odorata*) is a rare species found on the island growing at the high tide line (Rhoads 2004). Other rare, threatened, or endangered species known to occur at Little Tinicum Island include: spike-rush (*Eleocharis obtusa* var. *peasii*), dwarf spike-rush (*Eleocharis parvula*), mud-plantain (*Heteranthera multiflora*), long-lobed arrowhead (*Sagittaria calycina* var. *spongiosa*), strap-leaf arrowhead (*Sagittaria subulata*), and Smith's bulrush (*Scirpus smithii*) (Rhoads 2004).

3.3 - Economic and Cultural Environment

The Delaware Estuary's geographical location makes it a major transport corridor and a thriving industrial center. Because of its commercial value and unique and abundant biodiversity, the Delaware Estuary has become a cultural resource of historical significance, and a recreational resource for millions of residents and visitors.

The Delaware Bay and River are home to the nation's sixth largest port and third largest petrochemical port. Approximately 3,000 deep draft vessels arrive each year, and it is the largest receiving port in the U.S. for very large crude carriers (tank ships greater than 125,000 deadweight tons). Nearly 42 million gallons of crude oil are moved daily on the Delaware River. The port system generates approximately $19 billion in annual revenue and is home to five of the nine largest east coast refineries.

The Delaware River and Estuary has been a cultural resource for thousands of years. The Lenape Indians settled the watershed in more than 40 communities and lived there peacefully until European arrival (Weslager and Heite 1988). Dutch, Swedish, English, and Finnish colonists were the first Europeans to settle in the watershed (Sutton et al. 1996) and since then, the area has been an important port for moving goods. The construction of Fort Delaware, now a Delaware state park, began on Pea Patch Island during the War of 1812, but it was not used until the Civil War when it became a federal prison (Weslager and Heite 1988).

Although fish and oyster populations have declined from historical levels, both commercial and recreational fishing are still significant economic and popular activities in the Delaware River. Shad, sturgeon, and oyster fisheries were once big business: the shad fishery brought in $10 million/year (2008 dollars) in 1896; in 1887, 1,400 sailing vessels harvested 22 million pounds of oysters. Around the turn of the century, harvest pressure combined with deteriorating water quality and habitat to depress populations significantly. Today, shad cannot reach historical spawning grounds because hundreds of small unused dams still stand. Since 1991, however, fish ladders have opened approximately 165 river miles for fish migration in the Delaware River

Estuary, and dam removal projects are receiving increasing attention. With improved water quality since the Clean Water Act in the 1970s, commercial shad fishing is viable again in the Delaware, although no estimates of its magnitude were found. In 1996, the economic value of the shad sport fishery in the Delaware was estimated at $3.2 million. All sturgeon harvesting was halted in 1998 because populations were not rebounding. Although oyster populations are a fraction of their historic size in the 19th and early 20th centuries, populations in Upper Delaware Bay remain relatively robust. Therefore, it is likely the oyster population will continue to support commercial harvests.

As a recreational resource, the Delaware River is important to thousands of people who enjoy a variety of water-related activities, including boating, rowing, picnicking, bird watching, and hunting. Rural areas of the watershed support a large hunting contingent, particularly for waterfowl (Sutton et al. 1996).

CHAPTER 4.0 - Injury Determination

This chapter describes the Trustees' efforts to quantify the nature and extent of injuries to natural resources and recreational uses resulting from the *Athos* incident. It begins with an overview of the data collected immediately following the spill as part of the "preassessment," followed by the Trustee determination to proceed with injury assessment and restoration planning. The remainder of this chapter describes the Trustees' damage assessment, with summaries of the injury assessment methods and results. The affected environment, for purposes of this preferred action, includes not only the waterways and shorelines that were oiled, but the larger regional watersheds, habitats, and ecosystem services affected by the spill. Geographically, the affected environment is generally considered the geographic region of the Delaware River and the lower reaches of its tributaries. For purposes of identifying potential compensatory restoration projects, the team focused within this same geographic area; the affected environment is that geographic area depicted in Figure 5. Broadly, the focus within that geographic area is on the physical and biological resources affected by the spill, i.e., the Delaware River, the primary tributaries to the Delaware River within that region, the riparian (streamside) habitats adjacent to those tributaries, and regional habitat areas that support resources affected by the spill. Section 4.3 provides a detailed description of the components of the affected environment considered in assessing injury and evaluated for identifying potential compensatory restoration projects. The information presented in this chapter provides a broad overview of the areas and services affected by the spill and how these guide the affected environment considered for restoration action. In order to achieve the objectives of compensating for interim losses and services pending recovery of injured resources, compensatory restoration projects are identified within this affected environment and are areas not directly impacted by the spill.

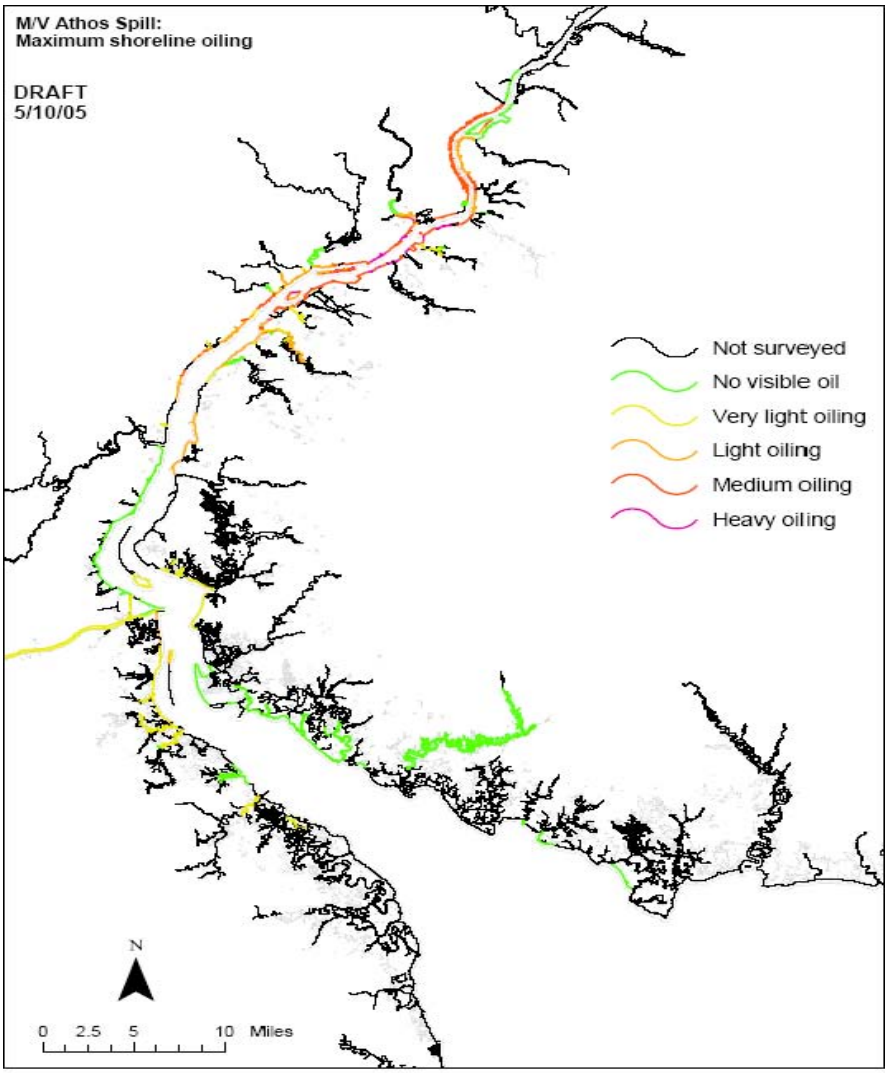


Figure 5. Maximum extent of shoreline oiling in the Delaware River and its tributaries.

4.1 - Overview of Preassessment Activities and Findings

The Trustees initiated preassessment activities on 27 November 2004, immediately following notification of the spill. Preassessment activities, as defined by OPA, focused on collecting ephemeral data essential to determine whether: (1) injuries have resulted, or are likely to result, from the incident; (2) response actions have adequately addressed, or are expected to address, the injuries resulting from the incident; and (3) feasible restoration actions exist to address the potential injuries.

Preassessment efforts for the *Athos* incident included characterization of the spilled oil; water, sediment, and biological resource sampling and analyses; and shoreline and aerial surveys. These efforts were conducted cooperatively with the RP. The Trustees' Preassessment Data Report (NOAA 2006; http://www.darrp.noaa.gov/northeast/athos/index.html) details these efforts and findings. This section provides a general overview of the preassessment efforts.

Characteristics of the Spilled Product

Source oil samples taken from the *Athos* were analyzed to identify the composition of the oil and allow for comparison of its chemical "fingerprint" to oil collected in the Delaware River environment. In general, the data and analyses indicated that the *Athos* was carrying a heavy Venezuelan crude oil (Bachaquero), a slightly buoyant, very viscous, and sticky cargo that weathers slowly and has high asphalt content. On a wet weight mass basis, specific polycyclic aromatic hydrocarbons (PAHs) in the source oil represented 0.5 percent of the total oil mass (NOAA 2006). Thus, 99.5 percent of the source oil, on a mass basis, was something other than specific target PAHs, presumably, asphaltenes and other high molecular weight refractory organics. These compounds, which have limited aqueous solubility and, therefore, toxicity, were present as a non-aqueous phase liquid that became dynamically attached to the bottom (see following section describing subsurface oil observations). This inhibits oxygen transfer to the bottom, and benthic aquatic life can smother and die.

While the percentage of specific PAH compounds in the source oil was low, the PAHs in the oil were inherently toxic and capable of harming aquatic life. The estimated potency of the PAH mixture was 41.9 acute toxic units and 213 chronic toxic units. About 33 percent of this toxicity was due to naphthalenes, 37 percent was due to fluorenes and phenanthrenes, 17 percent was due to dibenzothiophenes, and the balance was due to other specific PAHs (R. Greene, personal communication; NOAA 2006).

Subsurface Oil Observations

Sonar, coring, sorbent probes, "snare samplers"[7], and a Vessel-Submerged Oil Recovery System (V-SORS)[8] were used to search for subsurface oil. Pooled stranded oil was found at the collision site in two trenches, with a total volume estimated between 3,390 and 3,610 gallons (NOAA 2006). Subsurface oil suspended off the bottom (and mobile) was detected around Little Tinicum Island and, intermittently, in the middle spill zone area below the island. No, or less than 1 percent, oil was observed on any of the snare samplers in the upper Delaware Bay (NOAA 2006).

Water Column Sampling

In the first 2 weeks following the incident, 66 surface water and 13 bottom water samples were collected to characterize PAH concentrations and assess potential injuries to aquatic resources. The Final Preassessment Data Report (NOAA 2006) presents sample locations and PAH concentrations found in the water column samples. Total PAH in the samples ranged from 25 to 26,634 ng/L (parts per trillion) total PAHs. Only two samples (at Marcus Hook and downstream of the mouth of the Schuylkill River) exceeded chronic toxicity thresholds (Neff et al. 2005), both for alkylated chrysenes and alkylated phenanthrene/anthracenes. No volatile organics were

[7] Snare samplers are crab pots with oil adsorbents attached and consist of an anchor, 50 feet of oleophilic snare on a rope, and a float.

[8] V-SORS consist of a pipe with attached chains and snare material. They are towed behind a vessel on the bottom.

detected within the reporting limits (NOAA 2006). The Trustees' final Aquatic Injury Assessment Report (Aquatic TWG 2007) addresses determination of the source of PAHs (background existing PAHs versus those contributed by the *Athos* spill).

Subtidal and Intertidal Sediment Sampling

From 9 December through 17 December 2004, 28 subtidal and 11 intertidal sediment samples were collected throughout the river and analyzed to characterize PAH concentrations and assess the potential injuries to benthic aquatic organisms. Subtidal sediment samples were also collected from three Delaware River Estuary sites included in NOAA's National Status and Trends Program Mussel Watch Project on 2 January 2005 to compare post spill and historical data. Sample locations and PAH concentrations found in the sediment samples are presented in NOAA (2006). Total PAHs in subtidal samples ranged from 209 to 23,985 ng/g dry parts per billion (ppb); intertidal samples ranged from 948 to 44,022 ng/g dry (NOAA 2006). Sourcing of PAHs between background and *Athos* PAHs is considered in the Trustees' final Aquatic Injury Assessment report (Aquatic TWG 2007).

Sediment Toxicity Triad

The Delaware Department of Natural Resources & Environmental Control (DNREC) collected whole sediment samples from the vicinity of Little Tinicum Island, Claymont/Oldmans Point, and Pea Patch Island to assess potential injury to sediment-dwelling organisms. Surficial (0-2 inches) sediment grabs were analyzed with a sediment quality triad approach that included measuring PAHs and total organic carbon concentrations, evaluating the toxicity of whole sediment samples to the amphipod *Leptocheirus plumulosus* in 10-day toxicity tests, and assessing benthic aquatic invertebrate community structure (EA Engineering 2005a, 2005b, 2005c; R. Greene, personal communication). The results of the toxicity tests indicated that the samples collected in the vicinity of Little Tinicum Island were toxic to amphipods on 15 December 2004 and 17 February 2005.

Oyster Tissue Analyses

The Trustees and RP collected oyster samples to determine potential risks to: (1) human health from consumption; (2) oysters based on contaminant body burden; and (3) piscivorous animals that might consume tainted oysters. Sample locations and PAH concentrations found in the oyster tissue samples are presented in NOAA (2006). Oyster tissue PAH ranged from 13.2 to 28.9 ng/g wet weight (ppb), below thresholds of concern for human health and bioaccumulation in piscivorous mammals (Sample et al. 1996).

Fish Tissue Analyses

The Trustees and RP collected perch, catfish, and gizzard shad from the river for tissue analysis (fillet and whole-body) from 9 December through 16 December 2004 and adult striped bass in May and July 2005. Sample locations and PAH concentrations found in the fish tissue samples are presented in NOAA (2006). Samples ranged from 88.9 to 464.3 ng/g wet weight (whole body, catfish); 72.1 to 238.9 ng/g wet weight (fillet, perch, and shad); 205.6 to 1143.6 ng/g wet

weight (carcass, perch and shad); 9.7 to 130.6 ng/g wet weight for striped bass fillets; and 11.5 to 291.5 ng/g wet weight for striped bass carcasses. Lipid-normalized concentrations of PAHs were below the threshold for PAH-induced narcosis in fish (DiToro et al. 2000), the benzo[a]pyrene threshold of concern for bioaccumulation in piscivorous mammals (Sample et al. 1996), and the threshold that would trigger a fish advisory when using EPA guidance numbers (cancer health endpoint).

Horseshoe Crabs and Whelk Surveys

Twenty-three dredge tows were made in the upper bay on 18 March 2005 by DNREC to collect and observe horseshoe crabs (*Limulus polyphemus)* and knobbed whelks (*Busycon carica*) (NOAA 2006). A total of 136 horseshoe crabs and 477 knobbed whelks were examined. No oil was observed on these animals.

DNREC and the New Jersey Department of Environmental Protection (NJDEP) also conducted horseshoe crab spawning surveys in May and June 2005. Thirteen beaches in Delaware (130 kilometers of shoreline) and 11 beaches in New Jersey (80 kilometers of shoreline) were surveyed, with no observations of oil on the beaches or the horseshoe crabs.

Monitoring also indicated no oil on the exoskeleton of the approximately 8,700 horseshoe crabs collected from the U.S. Geological Survey tagging surveys conducted in the bay between March and May 2005.

Shoreline Cleanup Assessment Surveys

Shoreline Cleanup Assessment Teams (SCAT) surveyed shorelines within and adjacent to the spill zone on a nearly continuous basis from 29 November 2004 to 13 February 2005 to document the extent and magnitude of oiling (i.e., length and width of oiling, percent of oil coverage, oil character and thickness, and habitat conditions). Approximately 550 miles of shoreline were surveyed with about 280 miles oiled to varying degrees (Figures 6a-e). Table 2 and Figure 5 summarize shoreline oiling information.

Figure 6. Representative examples of shoreline oiling observation: a. Oiled seawall; b. Oiled sand beach; c. Oiled coarse substrate beach; d. Oiled intertidal mud flat; e. Oiled marsh.

Table 2. Approximate length in miles of shoreline habitat by oiling degree (excluding tributaries). See Shoreline Assessment Team (2007) for definition of oiling categories.

Habitat	Very Light	Light	Moderate	Heavy	Total
Seawalls	13	24	37	4	78
Sand/Mud Substrate	18	11	10	6	45
Coarse Substrate	37	18	9	5	69
Marsh	70	20	4	2	96
Total	138	73	60	17	288[a]

[a] The total length is greater than the total length of oiled shoreline because some segments have two habitat types present.

Vegetative Assessment of Little Tinicum Island

On 16 December 2005, Dr. Ann Rhoads with the Morris Arboretum of the University of Pennsylvania surveyed the tidal mud flats and lagoons of Little Tinicum Island. Plants on the tidal flats included dormant leaves of spatterdock (*Nuphar advena*), sweetflag (*Acorus calamus*), arrowhead (*Sagittaria rigida*), arrow-arum (*Peltandra virginica*), and dwarf spike-rush (*Eleocharis parvula*). The leaves of many, but not all, of these plants exhibited black deposits of oil. Oil deposits were also observed on vegetation, rocks, debris, and the sand along the high tide line; the intensity of the deposits varied depending on the exposure of each section of shoreline. Those areas most open to the east (upstream direction) were the most severely affected. Thick black oil coated the lower 1 to 3 feet of dead stems of common reed (*Phragmites australis*), purple loosestrife (*Lythrum salicaria*), swamp-mallow (*Hibiscus moschuetos*), and smartweed (*Polygonum sp.*). Stems and exposed roots of woody plants, including shrubs such as arrow-wood (*Viburnum dentatum*), groundsel-tree (*Baccharis halimifolia*), black elderberry (*Sambucus canadensis*), false indigo (*Amorpha fruticosa*), and trees were also coated to a height of about 12 inches at the base. In a few areas near the east (upstream) end of the island, oil had soaked into the sand and gravel surface just below the high tide line forming an asphalt-like crust.

Wildlife Response and Rescue Operations

Immediately following the spill, search teams began patrolling oiled shoreline areas and coordinating observations of dead and oiled wildlife with response/cleanup crews, wildlife ground survey crews, and Tri-State Bird Research and Rescue in Delaware. Wildlife rehabilitation was conducted at the Frink Center for Wildlife in Newark, Delaware, and the John Heinz Wildlife Refuge in Philadelphia. By May 2005, a number of oiled birds were observed (Figure 7); 206 birds were collected dead or died at the rehabilitation center, and 337 birds were rehabilitated and released alive (E. Marek, personal communication) (Table 3). Other dead wildlife recovered included three turtles, one squirrel, one opossum, one red fox, and one woodchuck (E. Marek, personal communication). Search teams also recovered 23 dead fish, oiled to varying degrees, including two bullhead catfish (*Ameiurus nebulosus)*, two striped bass (*Morone saxatilis*), 15 white perch (*Morone americana)*, and one gizzard shad (*Dorosoma cepadianum*) (E. Marek, personal communication).

Figure 7. Observed oiled birds.

Table 3. Summary of recovered birds from the rehabilitation center.		
Species	**Rehabilitated/Released**	**Dead**
American black duck	2	1
Blue-winged teal	-	1
Duck *sp*.	-	2
American coot	-	1
Mallard	11	25
Bufflehead	3	1
Canvasback	-	1
Long-tailed duck	-	1
Ruddy duck	-	1
Black scoter	-	1
Double-crested cormorant	-	9
Northern gannet	-	1
Great black-backed gull	-	2
Gull *sp*.	-	22
Herring gull	7	26
Ring-billed gull	25	17
Belted kingfisher	-	3
Canada goose	287	80
Mute swan	-	1
Snow goose	2	6
Great blue heron	-	2
Unidentified	-	2
Total Wild	**337**	**206**
Domestic geese	32	1
Domestic ducks	36	1

Wildlife Ground Surveys

Trustees and the RP conducted more than 3,400 ground surveys between 30 November 2004 and 10 January 2005 to estimate the extent and degree of oiling of non-recovered wildlife (NOAA 2006). Nearly 157,500 birds were counted; about 16,500 (10 percent) had some degree of oiling. About 72 percent of all oiled birds observed had trace or light oiling; 19 percent of oiled birds were moderately oiled; and 9 percent of oiled birds were heavily oiled.

The most common species observed are reported in Table 4. Geese represented nearly half of all observed oiled birds. Canada geese, mallards, and gulls made up 91 percent of observed oiled birds.

Table 4. Most common birds observed oiled during ground surveys.		
Species Name	**Total Oiled Birds Observed**	**Percent of all Oiled Birds**
Canada Goose	8041	49
Great black-backed gull	469	3
Herring gull	915	6
Mallard	447	3
Ring-billed gull	5422	33

Aerial Bird Surveys

Trustees and the RP conducted 11 aerial surveys between 28 November 2004 and 28 December 2004 to assess the species composition and abundance of birds in the spill area (NOAA 2006). The number of birds observed during each of these surveys, along with the general location of the flight, is presented in Table 5. Total observed birds ranged from about 2,600 on 3 December 2004 to nearly 100,000 on 5 December 2004. While these counts do not reflect a standard flight time or area covered, in general, more birds moved into the area in December as it became colder.

Table 5. Aerial bird survey summary. Counts by species are presented in NOAA (2006).			
Date	**Number of Birds Observed**	**Predominant Species Observed**	**Area Surveyed**
28-Nov	3,392	Black ducks, mallards, buffleheads, gulls, Canada geese	Portion of north N.J. shoreline
29-Nov	7,555	Black ducks, gulls, Canada geese	Portion of north N.J. shoreline
30-Nov	5,030	Black ducks, mallards, ruddy ducks, buffleheads, gulls, Canada geese	N.J. and Pa. shorelines
2-Dec	59,123	Black ducks, green-winged teal, mallards, ruddy ducks, buffleheads, gulls, Canada geese, snow geese	Del. and N.J. shorelines
3-Dec	2,577	Mallards, gulls, Canada geese	Pa. shoreline
5-Dec	98,245	Black ducks, gadwall, green-winged teal, mallards, pintails, buffleheads, ruddy ducks, scaup, gulls, gannet, Canada geese, snow geese, swans	N.J., Pa., and Del. shorelines
9-Dec	12,716	Black ducks, green-winged teal, mallards, pintails, ruddy ducks, gulls, Canada geese	Portions of N.J. and Pa. shoreline
13-Dec	17,825	Black ducks, green-winged teal, mallards, pintails, gulls, Canada geese	North N.J. and Pa. shoreline

15-Dec	70,209	Black ducks, green-winged teal, mallards, gulls, Canada geese, swans, snow geese	Del. and south N.J. shorelines
16-Dec	51,096	Black ducks, green-winged teal, mallards, pintails, gulls, Canada geese, greater white-fronted geese	Del. and south N.J. shorelines
21-Dec	19,516	Black ducks, mallards, pintails, canvasback, merganser, gulls, Canada geese	North N.J. and Pa. shorelines

Lost Recreational Use

Following the incident, the state of Delaware closed certain public wildlife areas to hunting and the USCG closed portions of the Delaware River to boat traffic. State lands in Delaware were closed to hunting as far south as Cedar Swamp Wildlife Area, with advisories issued to hunting on private lands in the region. The closures were in effect for about 2 weeks. In New Jersey, most areas within 5 miles of the river—from the Tacony-Palmyra Bridge to the nuclear power facility in Salem, New Jersey—had recommendations that waterfowl not be hunted in proximity to the river.

As part of the preassessment effort, the Trustees and RP collected data to determine the potential for loss of human uses, including hunting, boating, fishing, crabbing, and beach and other shoreline use. Shoreline use was documented during several overflights. Interviews with marina owners were conducted to determine the potential impacts to recreational boating. In general, the level of recreational boating at the time of the incident appeared low, although some boat-based fishing typically continues throughout the year.

4.2 - Trustee Determination Based on Preassessment Findings

Based on findings summarized in Section 4.1 and detailed in the Trustees' Final Preassessment Data Report (NOAA 2006), the Trustees determined that the following four types of natural resources or services were injured, or were likely to be injured, by the *Athos* incident: (1) shorelines; (2) birds and wildlife; (3) aquatic resources; and (4) recreational use. The Trustees also determined that a number of potential restoration actions exist to compensate for the losses and, consistent with the OPA regulations (15 CFR 990), proceeded with injury assessment and restoration planning efforts.

4.3 - Injury Assessment Strategy

The goal of injury assessment is to determine the nature and extent of injuries to natural resources, thus providing the technical basis for evaluating and scaling restoration actions. OPA defines injury as "an observable or measurable adverse change in a natural resource or impairment of a natural resource service." "Loss of use of natural resources," i.e., diminished quantity and/or quality of recreational use of natural resources, is also a compensable injury under OPA.

The Trustees worked cooperatively with the RP to assess losses in each of the four categories of injury – shorelines, birds and wildlife, aquatic resources, and recreational use. Assessments

focused on determining both the magnitude of the injury and the time to full recovery. This analysis was accomplished for birds by multiplying the number of lost animals[9] by the recovery period to generate the units of bird-years. For shoreline, intertidal, and benthic habitats, injuries were quantified as service acre-years, where a service acre-year is the flow of benefits that one acre provides over the period of 1 year. Recreational losses were calculated as the number of trips not taken to the spill zone and the diminished value of trips that were taken, expressed in dollars. All injury estimates in future years were discounted at 3 percent per year (NOAA 1999), summed, and added to the injury in the year of the spill, yielding an estimate of total injury. People have a rate of time preference and prefer to use or consume goods and services in the present rather than postpone their use or consumption to some future time. Discounting is used to make dollars, resource service flows, and other units that occur in different time periods comparable. The discounted values from different time periods are then in a common unit and can be summed. All of these methods produce an estimate of direct plus interim (from the time of injury until full recovery) losses of resources resulting from the oil.

Federal and state scientists and consultants with damage assessment experience conducted the injury assessments. Each assessment was conducted in full cooperation with the RP, with the goal of reaching consensus among all parties. In the end, each assessment concluded with consensus among the Trustee representatives. Where technical disagreement with the RP occurred, the Trustees placed the RP comments, along with Trustee responses, in the Administrative Record (AR), where they are available for public review (see Section 2.1.1.4).

Prior to finalizing the four assessments, the Trustees retained outside experts to peer review the injury reports, the RP comments, and Trustee responses to those comments. Where appropriate, the Trustees modified each report to address peer review comments prior to final approval. Final injury reports and peer review comments were then placed into the AR, where they are available for public review (see Section 2.1.1.4).

The Trustees recognize that there is some uncertainty inherent in the assessment of impacts from oil spills. While in certain instances collecting more information may increase the precision of the Trustees' assessment of the *Athos* impacts, the Trustees believe that the type and scale of restoration actions would not substantially change as a result of further study. Throughout the assessment process, the Trustees sought to balance the desire for more information with the reality that further study would delay the implementation of the restoration projects, at the expense of the local environment and those who use and enjoy the area's natural resources. As part of the planned restoration efforts, the Trustees will conduct a comprehensive monitoring effort to evaluate the effectiveness of the restoration projects.

The following sections of this final Plan summarize each of the four injury assessments.

4.3.1 - Shoreline Injury Assessment

[9] The number of birds killed included both the direct (i.e., dead adults) and indirect losses (i.e., lost productivity due to mortality and reproductive failure of fledged young, see Section 4.3.2).

The shoreline injury assessment focused on (1) determining the geographic extent and degree of oiling by habitat type and (2) quantifying ecological service losses based on the degree of initial injury and rate of recovery of mainstem shoreline, intertidal, subtidal areas, and tributary systems. Shorelines specifically include seawall, sand/mud substrate, coarse substrate, and marsh habitats. Tributaries, which were treated as one system or habitat type, include shorelines, wetlands, intertidal flats, and shallow benthic habitats. SCAT survey data, Trustee follow-up surveys, chemical analyses of the oil and sediment, information on cleanup methods and chronic oil exposure after cleanup, life histories of the associated fauna and flora, and relevant studies from past spills were used to delineate oiled shoreline areas and determine the ecological service losses resulting from this incident.

Geographic Extent and Degree of Oiling

SCAT surveys and supplemental ground and aerial observations indicated that about 280 miles of shoreline (see Section 4.1) and nearly 1,400 acres of intertidal and tidal habitat (Table 6) were exposed to *Athos* oil. The river shoreline consisted of four general habitat types: seawalls, sand/mud substrates, coarse substrates, and marshes. The majority of shoreline habitats exposed to oil were coarse substrate (137 acres) and marshes (116 acres). The intertidal areas, which were delineated off heavily and moderately oiled shorelines, consisted of sand/mud substrate. The degree of shoreline and tidal flat oiling ranged from very light, to light, moderate, and heavy. Intertidal oiling was either light or very light (Table 6).

Table 6. Total estimated shoreline and tributary area (acres) exposed to *Athos* oil.

Habitat	Oiling Level	Shoreline	Lower Intertidal	Tidal Flat	Total by Habitat	Percent of Total Oiling
Seawalls	Very Light	8.66			8.66	0.50
	Light	17.72			17.72	1.02
	Moderate	30.46			30.46	1.76
	Heavy	2.54			2.54	0.15
Subtotals		**59.38**			**59.38**	**3.43**
Sand/Mud Substrate	Very Light	7.39	55.69	677.43	740.51	42.83
	Light	9.98	26.94	279.54	316.46	18.30
	Moderate	9.94		205.48	215.42	12.46
	Heavy	8.24		135.20	143.44	8.30
Subtotals		**35.55**	**82.63**	**1,297.65**	**1,415.83**	**81.89**
Coarse Substrate	Very Light	16.23			16.23	0.94
	Light	66.08			66.08	3.82
	Moderate	36.91			36.91	2.13
	Heavy	18.01			18.01	1.04

Subtotals		**137.23**			**137.23**	**7.94**
Marsh	Very Light	51.83			51.83	3.00
	Light	40.89			40.89	2.36
	Moderate	17.22			17.22	1.00
	Heavy	6.53			6.53	0.38
Subtotals		**116.47**			**116.47**	**6.74**
TOTAL MAINSTEM HABITATS					**1,728.91**	
Tributaries	Very Light	583.25			583.25	30.71
	Light	1,216.08			1,216.08	64.03
	Moderate	99.90			99.90	5.26
TOTAL TRIBUTARY HABITATS					**1,899.23**	

Six tributaries were also exposed to *Athos* oil. SCAT data for these areas, however, were more limited, and degree of oiling was generally less than mainstem shoreline areas. Consequently, oiled tributaries were treated as entire systems (i.e., one habitat type), where open water, isolated wetlands, wetland fringe along the shoreline, and associated tidal flats were assigned an appropriate oiling category based on aerial observations of the extent and thickness of sheens, SCAT surveys, and other ground observations. The six tributary systems exposed to *Athos* oil totaled nearly 1,900 acres, with the degree of oiling ranging from very light to moderate (Table 6).

Table 6 summarizes the estimated shoreline and tributary area exposed to *Athos* oil. More information on the methods to estimate the area of exposure for each habitat type and degree of oiling is provided in the final Shoreline Injury Assessment (Shoreline Assessment Team 2007).

Quantification of Losses

Mainstem shoreline, intertidal, subtidal, and tributary injuries were quantified as service acre-years, where a service acre-year is the flow of benefits that 1 acre provides over the period of 1 year. For each habitat type, a Habitat Equivalency Analysis (HEA) model was developed to calculate the loss of ecological services, expressed in discounted service-acre years (DSAYs). HEA is a resource-to-resource scaling method to determine compensation for lost services based on the quantification of incident-related natural resources injuries. The following summarizes the injury quantification for each oiled habitat type, including the Trustees' determination of the initial impact and rate of recovery.

Seawalls

Approximately 59 acres of seawalls were oiled and/or affected by cleanup operations, with the majority observed as moderately oiled (30 acres) (Table 6). Oil attached to the dry, rough surface of the seawalls in a band above the high tide line. Shoreline cleanup consisted of high-pressure, hot-water flushing of the oil.

Table 7 presents the recovery over time and the number of DSAYs lost for each seawall oiling category. Initial losses of very lightly and lightly oiled seawalls were estimated to be at 5 and 15 percent of baseline, respectively. Few of these areas were subject to cleanup efforts, and the majority of the oil was removed by natural weathering processes within the first year. Very light and light oiling could have removed some habitats as suitable settling locations for invertebrates, however the majority of the seawalls functioned normally.

Seawalls that were moderately or heavily oiled experienced a much higher loss of primary production as well as a loss of invertebrates that depend on the algae for food. Initial loss of services due to moderately and heavily oiled seawalls was estimated to be 100 percent through the first 6 months after the spill because of the initial oiling and the effects of high-pressure, hot-water flushing cleanup operations. One year following the spill, the loss of services was estimated to be at 15 percent, reflecting the rapid recruitment of short-lived species. Because both moderately and heavily oiled seawalls were mostly treated with high-pressure, hot-water flushing in the spring of 2005, they have the same loss of services and recovery rates. Services provided by moderately and heavily oiled seawalls were estimated to have recovered by 2 years following the spill.

Based on the HEA parameters described above, total injury to the 59 acres of oiled seawalls was calculated as 30.3 DSAYs (Table 7). A full description of the assessment of seawall losses is provided in the final Shoreline Injury Assessment (Shoreline Assessment Team 2007).

Table 7. Estimated recovery rate and number of DSAYs lost for oiled seawalls.

Oiling Degree	Acres	Services Present Post Spill			DSAYs
		0.5 yr	1 yr	2 yrs	
Very Light	8.66	0.95	1		0.32
Light	17.72	0.85	1		1.97
Moderate	30.46	0	0.85	1	25.87
Heavy	2.54	0	0.85	1	2.16
Total	**59.38**				**30.32**

Sand/Mud Substrates

Approximately 1,416 acres of sand/mud substrates—including shoreline, intertidal, and tidal flats—were exposed to oil, of which 677 acres, or 48 percent, were very lightly oiled tidal flats (Table 6). On seawalls and other hard substrates, the effluent from flushing exposed the entire intertidal zone to oil. On beaches, the viscous oil coated the sediments, particularly gravel, and penetrated sandy sediments where it accumulated. Small tar balls that readily spread into sheens continued to be released from heavily oiled beaches throughout 2005. As late as September 2005, oil droplets and larger deposits of oil were observed in the sandy and muddy intertidal sediments at multiple locations along heavily oiled shorelines in Pennsylvania. This chronic release was a significant source of fouling to intertidal communities.

Table 8 presents the recovery over time, and the number of DSAYs lost for each sand/mud substrate oiling category. The loss of services for very lightly and lightly oiled areas was estimated to be 50 percent of baseline for the first 6 months after the spill. This category is dominated by tidal flats fronting heavily and moderately oiled shorelines that were constantly exposed to oil slicks, droplets, and sheens released from the shoreline. One year following the spill, the loss of services was estimated to be at 25 percent of baseline, based on the observations of oil droplets and sheens on all such tidal flats visited in September 2005, and the relatively short life history of most species associated with these habitats in the lower river. By the third year following the spill, services were expected to have recovered, assuming that the stranded oil would have weathered enough to prevent significant releases after year two, which would allow affected resources to recover by year three.[10]

Moderately and heavily oiled sand/mud substrates were estimated to have 100 percent loss of services 6 months after the spill. Based on best professional judgment, the stranded oil would have directly smothered and killed intertidal organisms, and the intensity of cleanup required to remove the viscous, persistent oil would have affected any remaining organisms and restricted use until termination of cleanup activities. Similar to the lighter oil categories, these two categories were estimated to recover within 3 years; however, the rate of return of services to baseline was estimated to be slower, leading to higher overall interim losses.
Based on the HEA parameters described above, total injury to the 1,416 acres of sand/mud substrates was calculated as approximately 1,117 DSAYs (Table 8). A full description of the assessment of sand/mud substrates losses is provided in the final Shoreline Injury Assessment (Shoreline Assessment Team 2007).

Table 8. Estimated recovery rate and number of DSAYs lost for oiled sand/mud substrates.

Oiling Degree	Acres	Services Present Post Spill				DSAYs
		0.5 yr	1 yr	2 yr	3 yr	
Very light	740.51	0.5	0.75	0.95	1	443.02
Light	316.46	0.5	0.75	0.9	1	204.24
Moderate	215.42	0	0.5	0.8	1	278.06
Heavy	143.44	0	0.5	0.75	1	191.91
Total	**1,415.83**					**1,117.24**

Coarse Substrate

Approximately 137 acres of coarse substrate were exposed to oil, with the majority being lightly oiled (66 acres) (Table 6). This habitat was dominated by rip-rap, where cleanup was difficult and often involved intensive high-pressure, hot-water flushing. In September 2005, tarry oil layers and oil droplets in the underlying sediments were observed in all heavily oiled rip-rap areas visited.

[10] A full site visit has not been undertaken since 2005.

Table 9 presents the recovery over time, and the number of DSAYs lost for each coarse substrate oiling category. Very lightly oiled areas were estimated to have a 25 percent loss of services 6 months after the spill, a 15 percent loss after 1 year, a 5 percent loss after 2 years, and complete recovery 3 years following the spill. For lightly oiled coarse substrates, the injury was estimated at a loss of 50 percent of services 6 months after the spill, a 25 percent loss after 1 year, a 10 percent loss after 2 years, and full recovery after 3 years. These recovery estimates were based on direct smothering effects of the oil and the short life history of fauna associated with these mostly man-made habitats.

Heavy and moderately oiled coarse substrates were estimated to have 100 percent loss of services until 6 months after the spill. All fauna was predicted to be smothered in oil and likely experience high mortality from both the oil and subsequent high-pressure, hot-water flushing during cleanup. The habitat would not be available for shorebirds until termination of cleanup activities. Lost services were estimated to be at 50 percent of baseline at 1 year following the spill, reflecting both the recovery of some services after the initial impacts and on-going impacts resulting from persistent oil on the rip-rap blocks and chronic exposures to oil released during 2005. Lost services were estimated to be 25 percent at 2 years and 10 percent by the third year. Moderately oiled coarse substrate shorelines were estimated to fully recover after 4 years. Heavily oiled coarse substrate would likely have minor injuries extending out to 5 years after the spill.

Based on the HEA parameters described above, total injury to the 137 acres of oiled coarse substrates was calculated as approximately 127 DSAYs (Table 9). A full description of the assessment of coarse substrate losses is provided in the final Shoreline Injury Assessment (Shoreline Assessment Team 2007).

Table 9. Estimated recovery rate and number of DSAYs lost for oiled coarse substrates.

Oiling Degree	Acres	Services Present Post Spill						DSAYs
		0.5 yr	1 yr	2 yr	3 yr	4yr	5yr	
Very light	16.23	0.75	0.85	0.95	1			5.53
Light	66.08	0.5	0.75	0.9	1			42.65
Moderate	36.91	0	0.5	0.75	0.9	1		52.76
Heavy	18.01	0	0.5	0.75	0.9	0.99	1	25.90
Total	**137.23**							**126.84**

Marsh

Approximately 116 acres of marsh were exposed to oil, with about 93 acres, or 80 percent, very lightly or lightly oiled (Table 6). Oil that stranded in the marshes mostly coated the intertidal vegetation and debris and, along moderately and heavily oiled shorelines, stranded and persisted on the sediments. In September 2005, the Trustees observed oil released from marsh soils when disturbed, indicating on-going oil exposure to both epifauna and infauna in these habitats (Shoreline Assessment Team 2007).

Table 10 presents the recovery rate over time and the number of DSAYs lost for each marsh oiling category. Very lightly oiled marsh was estimated to have lost 25 percent of services 6 months after the spill occurred, as a result of the oil coating vegetation. After 1 year, services would have recovered to 95 percent of pre-spill conditions, reflecting the return of most associated fauna. Full recovery was expected within 2 years after the spill. Lightly oiled marshes followed a similar pattern but had an estimated 50 percent of services lost and 25 percent lost 1 year after the spill.

For moderately and heavily oiled marshes, service losses were estimated to be 100 percent for the first 6 months, until new vegetation emerged to replace oiled vegetation. Oil would have smothered most organisms within the oil band and wildlife would not have been able to use the area for feeding. Moderately oiled marshes were estimated to lose 25 percent of services 1 year after the spill, 5 percent loss of services after 2 years, and recover after 3 years. Heavily oiled marshes were estimated to have a 50 percent loss of services 1 year after the spill, 25 percent loss of services after 2 years, 10 percent loss of services after 3 years, and recover after 4 years.

Based on the HEA parameters described above, total injury to the 116 acres of oiled marsh was calculated as approximately 60 DSAYs. A full description of the assessment of marsh losses is provided in the final Shoreline Injury Assessment Report (Shoreline Assessment Team 2007).

Table 10. Estimated recovery rate and number of DSAYs lost for oiled marsh.

Oiling Degree	Acres	Services Present Post Spill					DSAYs
		0.5 yr	1 yr	2 yrs	3 yrs	4yrs	
Very light	51.83	0.75	0.95	1			11.47
Light	40.89	0.5	0.75	1			22.54
Moderate	17.22	0	0.75	0.95	1		16.68
Heavy	6.53	0	0.5	0.75	0.9	1	9.33
Total	**116.47**						**60.02**

Tributaries

Six tributaries in New Jersey—totaling approximately 1,899 acres of shorelines, wetlands, intertidal flats, and shallow benthic habitats—were exposed to *Athos* oil (Table 6). The majority of tributaries were lightly oiled (1,216 acres), described as extensive dull to rainbow sheens on the water. Oil slicks that stranded on the intertidal areas coated the habitat and any organisms using the shoreline. Oil sheens and slicks on the water surface impacted water quality and reduced the use of these habitats by wildlife such as birds and aquatic mammals. The shallow benthic habitats commonly used by fish and crabs for feeding, protection from predators, and spawning were also affected by floating oil, naturally dispersed oil, and submerged oil. Because some of the oil became submerged, oil may have contaminated the benthic resources at the mouths of these tributaries by attaching to particulate matter in the water column, becoming heavier and sinking in these low-energy habitats. In that situation, both smothering effects and chronic toxicity effects from PAHs could impact sediment biota.

Table 11 presents the recovery rate over time, and the number of DSAYs lost for each tributary oiling category. The initial service losses in the tributaries extended for the first 3 months following the spill, when floating oil was present. The floating oil had fouling and coating impacts to the shoreline, water surface, and upper water column resources. The tributaries have low dilution and flushing rates, thus oil in these systems affects a significant percentage of the resources present. Moderately oiled tributaries were estimated to have a service loss of 65 percent. These areas had black oil slicks on the surface and moderate shoreline oiling that could be a source of chronic releases of oil. Lightly oiled tributaries were estimated to have a service loss of 50 percent due to the light and very light shoreline oiling and the presence of extensive oil sheen. Very lightly oiled tributaries were estimated to have a service loss of 25 percent because of the presence of oil sheen on the water surface.

While the sediment samples in the tributaries were limited, the results of the preassessment (NOAA 2006) and September 2005 sediment analyses (Aquatic TWG 2007) are generally consistent with a finding of moderate impacts in the tributaries immediately following the spill, and recovery within 1 year. Additionally, no oil was observed along the shorelines or released from subtidal sediments during the 2005 site visits. Therefore, all oiled tributaries were assumed to have completely recovered within 1 year.

Based on the HEA parameters described above, total injury to the 1,899 acres of tributaries oiled as a result of the spill was calculated as approximately 524 DSAYs. A full description of the assessment of tributary losses is provided in the Final Shoreline Injury Assessment (Shoreline Assessment Team 2007).

Table 11. Estimated recovery rate and number of DSAYs lost for oiled tributaries.

Oiling Degree	Acres	Services Present Post Spill		DSAYS
		0.25 yr	1 yr	
Very light	583.25	0.75	1	108.16
Light	1,216.08	0.5	1	375.29
Moderate	99.9	0.35	1	40.08
Heavy	0			
Total	**1,899.23**			**523.53**

In summary, the resource injuries to shoreline, which included seawalls, sand/mud substrate, coarse substrate, marshes, and tributaries, totaled approximately 3,628 acres. Approximately 1,858 DSAYs were lost due to the spill.

4.3.2 - Bird and Wildlife Injury Assessment

The preassessment survey data indicate that a wide variety of birds was oiled by the *Athos* spill, and many died as a result of this exposure (see Section 4.1). Table 3 provides the list of the 206 birds that were collected dead, died at the rehabilitation center, or were not returned to the wild, as well as the 337 birds that were rehabilitated and released alive.

Because the number of birds recovered typically represents a fraction of the total loss, the Trustees and RP conducted an assessment to estimate the total number of birds that died and the loss of future production (Bird and Wildlife TWG 2007). This risk-based assessment used data from ground and aerial surveys to determine the full extent of bird and wildlife losses resulting from the *Athos* incident.

Ground surveys were conducted between 30 November 2004 and 21 January 2005. Nearly 157,500 birds were observed during the ground surveys, with about 16,500 (10 percent) having some degree of oiling. About 72 percent of all oiled birds observed had trace or light oiling; 19 percent of oiled birds were moderately oiled; and 9 percent of oiled birds were heavily oiled. Geese, dabbling ducks, and gulls made up nearly 98 percent of oiled birds observed, and 96 percent of all birds observed.

Eleven aerial surveys were conducted between 28 November 2004 and 21 December 2004 to assess the species composition and abundance of birds in the spill area (Table 5). The spill occurred during late autumn, when birds were immigrating, emigrating, and/or remaining to winter in the impact area. While this turnover of individuals is difficult to quantify precisely, more birds were present in the area later in December as it became colder.

In general, the total number of non-recovered birds present in the area was estimated from detectability-adjusted aerial survey data for each of nine guilds or species in three time periods. The number of birds in different oiling categories for each of these same guilds and time periods was estimated from ground survey data. This oiling information, with mortality rates derived from the literature and expert opinion, was then used to estimate the number of non-recovered birds that were oiled and died in the field, or that survived with potentially sublethal impacts. These estimates, combined with data on recovered birds from the wildlife rescue effort, were used to determine the total number of birds impacted.

Indirect injury in terms of production forgone due to the loss of future generations was included in the estimation of total injury. For the three guilds with the largest injury, lost production models were developed based on the characteristics of a representative species. These three guilds—dabbling ducks, swans/geese, and gulls—represented 94 percent of the direct mortality. The indirect injury was composed of two parts: (1) the discounted loss of production from dead individuals, projected 7 or 9 years from the time of the spill based on one-third of life expectancy; and (2) the discounted loss of production due to individuals that were oiled and survived, but failed to breed in the subsequent spring, calculated for one additional generation. Demographic and reproductive statistics for model species from each guild were used to estimate this loss with simple age-structured population models. Lost production in the remaining guilds was calculated based on the model for the most appropriate representative species.

A full description of the assessment of bird losses is presented in the final Bird and Wildlife Injury Report (Bird and Wildlife TWG 2007). Table 12 summarizes total estimated injury to birds, in individuals, from the spill by species guild. Direct injuries totaled 3,308 adult birds, the majority (75 percent) of which were gulls and geese. Additional estimated lost production from mortality and reproductive failure was 8,561 fledged young.

Table 12. Total (direct and indirect) estimated bird injury from the *Athos* spill by guild.

Guild	Direct Injury (Dead Adults)	Discounted Indirect Injury (Fledged Young)		TOTAL (Adults and Fledged Young)
		Lost Productivity (Mortality)	Lost Productivity (Reproductive Failure)	
Dabbling ducks	605	1,187	577	2,369
Diving ducks	82	163	24	269
Diving birds	64	92	2	158
Gulls	1,072	1,543	331	2,946
Shorebirds	55	79	0	134
Wading birds	10	14	3	27
Swans/geese	1,416	3,369	1,171	5,956
Kingfishers	4	6	0	10
Total	**3,308**	**6,453**	**2,108**	**11,869**

The Trustees also considered potential injuries to other wildlife. Separate assessments of potential injuries to muskrats, otters, and bald eagles concluded that there was no recorded mortality and little or no overall impacts (Bird and Wildlife TWG 2007). In addition, the Trustees concluded that there was no sufficient evidence of potential injuries to any other non-fish vertebrate wildlife species in the Delaware River spill area.

4.3.3 - Aquatic Injury Assessment

Preassessment data and findings (see Section 4.1) indicated that the oil from the *Athos* was a heavily biodegraded crude oil that had the potential to adhere to sediments and lose buoyancy (NOAA 2006). The characteristics of the spilled oil and its behavior in the environment suggest potential pathways of injury to aquatic organisms associated with the (1) physical smothering and fouling effects from oil, and (2) toxicity (including impacts on survival, reproduction, and growth) due to various constituents of the oil. Preassessment data did not, however, provide evidence of significant fish kills or significant water column losses.

The assessment of benthic losses was developed from intertidal and subtidal sediment samples, and information from V-SORS and use of snares. Of the 28 subtidal sediment samples collected during the preassessment[11], the highest total PAH concentration observed was 12.9 mg/kg dry weight (DW) in Woodbury Creek. Subtidal sediment samples collected near Little Tinicum Island (west and south of the island) had total PAH concentrations between 0.3 and 5.9 mg/kg

[11] Four subtidal samples were collected near Little Tinicum Island, 10 at Marcus Hook and points south, five above the Tacony-Palmyra Bridge, and nine in tributaries.

DW. Eleven intertidal sediment samples[12] were collected. Intertidal samples collected at Little Tinicum (on the eastern edge of the island) had total PAH concentrations between 15.0 and 24.4 mg/kg DW (NOAA 2006).

Subtidal sediment samples were also collected for the sediment quality triad study at Little Tinicum Island, Claymont, and Pea Patch Island approximately 1 and 3 months after the incident (NOAA 2006). The sediment samples collected in the vicinity of Little Tinicum Island on both dates presented both sheening and odor and were toxic to amphipods (as indicated by control-adjusted survivals of amphipods of 39 and 62 percent, respectively), while samples collected at the locations more distant from the spill origin did not exhibit toxicity that was significantly different from control samples. Chemical analysis on the two sediment samples from Little Tinicum Island indicated total PAH levels of 14.0 mg/kg DW and 6.8 mg/kg DW at 1 and 3 months after the incident. Based on PAH toxicity, neither sample was predicted to be acutely toxic, while the earlier sample was predicted to exhibit chronic toxicity to benthic biota. The sediment toxicity test does not specify the cause of mortality, which could arise from physical impacts, toxicity due to PAHs, unresolved complex mixture (UCM), other components of the spilled oil, and/or some other cause.

Additional subtidal sediment sampling was conducted in September 2005 to evaluate the potential extent of oiling 10 months after the release, and to evaluate the potential for longer-term ecological injuries (Aquatic TWG 2007). In total, 162 sediment samples (random stratified sampling plan) were collected between upstream of the Schuylkill River and downstream of the Delaware Memorial Bridge, covering approximately 20,000 acres (30 square miles). Screening PAH concentrations were determined for all samples using an ultraviolet fluorescence method, and, for 20 of the sediment samples, complete laboratory PAH and total organic carbon analyses were conducted. The results from the laboratory were used to estimate total PAH concentrations (i.e., based on the levels of the 13 parent PAHs) from the screening PAH concentrations for the remaining dataset. These levels were compared to estimates of the chemistry-toxicity relationship identified from prior sets of matched sediment chemistry and toxicity data.

The Trustees used a multi-step process to apply the HEA methodology to aquatic resource injury quantification for this spill. First, the spatial extent of injury was estimated, based on the simplifying assumption that subtidal impacts were most likely to occur in areas adjacent to heavy shoreline oiling, which is consistent with available V-SORS and sediment toxicity data. This approach resulted in a total injury area of 412 acres. Next, based on background contamination and toxicity data from prior studies, the Trustees identified a baseline service loss of 10 percent. Recovery rate and service losses for the affected area were then estimated for different periods following the spill based on toxicity tests, PAH levels, and benthic community information. Based on this approach, the Trustees believe that baseline conditions (i.e., no spill-associated service losses) were reached in 14 months, with a substantial impact on productivity in the months immediately following the spill. A HEA model was then developed using relevant inputs from the above analyses to estimate aquatic resource losses using a discounted service acre-years (DSAY) metric. Table 13 presents the HEA parameters and the total discounted injury to

[12] Eleven intertidal samples were collected from Crosswicks Creek, New Jersey, at the Tacony-Palmyra Bridge, in Raccoon Creek, New Jersey, and on Little Tinicum Island, Pennsylvania.

subtidal resources (97 DSAYs). A full description of the HEA model and injury assessment approach is provided in the Final Aquatic Injury Assessment (Aquatic TWG 2007).

Table 13. HEA parameters for estimated subtidal injury.

Injury Parameter	Value	Source/Notes
Injury area: acres with substantial subtidal oiling	412	Subtidal zones adjacent to heavily oiled shoreline (to 18' depth contour)
Background service loss	9.9%	Hartwell et al. 2001, mid-river region
Duration of injury	14 Months	
Recovery curve shape	Linear	Non-continuous at Month 3
Discount rate	3%	Standard rate used in NRDA analyses
Service loss anchor points		(*Athos*-related injury)
Month 1 (Day 19)	51%	Triad sample at Little Tinicum Island
Month 3 (Day 83)	28%	Triad sample at Little Tinicum Island
Month 10 (Day 295)	10%	September 2005 sediment sampling results
Results	Total DSAYs of Injury (subtidal) = 97 DSAYs	

During discussion of the available PAH chemistry data, the RP provided the Trustees with forensic petrochemistry analysis. The RP claimed that, based on PAH distributions, samples collected 10 months after the spill had less than 10 percent *Athos* oil in them (although one sample is estimated to have 15-20 percent *Athos* oil contributing to its PAH profile). After considering this information, the Trustees did not undertake additional fingerprinting analyses because: 1) available information suggests that multiple pathways contributed to estimated injuries, including physical effects as well as toxicity from PAHs, UCM, and/or other components of the oil; 2) estimated spill-related injuries are low 10 months after the spill (i.e., 10 percent), consistent with a modest contribution from *Athos* oil as suggested by RP fingerprinting analysis; and 3) few (four) subtidal samples were collected in earlier post-spill periods from the heavily oiled geographic areas that are the focus of this injury analysis. In the Trustees' judgment, further analysis on this or other topics is not warranted given the relatively modest injury quantification estimated in this analysis and the limited likelihood that additional time, effort, and expense will substantially improve the precision of associated estimates.

4.3.4 - Lost Recreational Use Injury Assessment

The Trustees and RP conducted an assessment of lost recreational uses resulting from the *Athos* incident (*Athos*/Delaware River Lost Use TWG 2007), determining that detailed evaluation of recreational fishing (shore and boat) and crabbing, waterfowl hunting, and pleasure boating was warranted. The assessment of these losses employed techniques common in the economic analysis of recreation. Surveys of recreational users were the primary source of information. Hunters were reached by telephone based on a list of people who purchased a hunting license.

Boaters, anglers, and crabbers were contacted in onsite surveys because no license is required for these activities (a fishing license is not required on saltwater portions of the river). In all of the surveys, respondents were asked to estimate the number of trips they took to the river during the season following the spill, and whether the spill affected their hunting, fishing, crabbing, or boating activities.

Affected trips were estimated in three categories. The term "lost" trips refers to a decline in trips to the river due to the spill. "Substitute" trips were those where there was a change in the location of trips to the river. "Degraded" trips refer to a decline in the quality of recreation trips.

Affected trips reported by survey respondents were extrapolated to account for the total number of trips potentially affected by the spill. For recreational fishing and crabbing, information on the total number of trips was estimated based on comprehensive surveys conducted for management purposes. The extrapolation included adjustments to correct for a potential problem in onsite surveys, namely, that people who lost trips due to the spill are less likely to be contacted. The survey could not account for those individuals who may have stopped using the river entirely, leading to a potential underestimate of affected trips.

For hunting, extrapolation to total trips used surveys conducted annually by the USFWS. For boating, extrapolation relied on estimates of total use derived from the number of boats moored at area marinas. The typical rate of boating use for moored boats was multiplied by the number of pleasure boats moored in the spill impact area.

The net benefit of a recreational activity refers to the public's willingness to pay to participate in the activity net of any actual monetary expenses. This type of "surplus value" (also known as "consumer surplus") is a measure of compensable losses under the NRDA regulations. For the *Athos* spill, the lost value associated with affected trips was estimated using benefit transfer methods. Benefit transfer involves the selection of appropriate per-trip values from previous studies of recreation in the economics literature. A report for the U.S. Department of Agriculture (Rosenberger and Loomis 2001) analyzes numerous such studies and presents values for a variety of recreational activities in specific regions of the United States. Values for the northeast region were available for recreational fishing[13] and waterfowl hunting[14] and were applied to the estimates of affected trips. Crabbing values were not available but were assumed to be the same as values for recreational fishing, an assumption that has minimal impact on damage estimates because the estimated number of affected crabbing trips was small. A nationwide value for motor boating was used in the assessment of pleasure boating.[15] While original data collection and site-

[13] Values for recreational fishing and crabbing were determined at $42.60/lost or substitute trips and $8.52/diminished trips in October 2008 dollars.

[14] Values for waterfowl hunting were determined at $43.88/lost or substitute trips and $8.78/diminished trips in October 2008 dollars.

[15] Values for pleasure boating were determined at $47.51/lost or substitute trips and $9.50/diminished trips in October 2008 dollars.

specific studies of recreational value are preferred, it was determined in this case that losses were not significant enough to warrant the expense of an original valuation study.

A summary of affected trips and lost value is presented in Table 14. Affected trips include lost, substituted, and degraded trips. Lost value is calculated by multiplying affected trips by the benefit transfer values noted above (*Athos*/Delaware River Lost Use TWG 2007). The number of recreational fishing/crabbing trips affected by the spill was estimated to be 20,652 leading to a loss in value of $679,435. The number of waterfowl hunting trips affected was 15,559 leading to a loss of $401,228. The number of pleasure boating trips affected was 5,498 causing a loss of $94,331. The estimate of the total number of affected trips was 41,709, and the estimate of total recreational use losses was $1,319,097. A discount factor has also been applied to account for the time between when damages occurred and when compensation is expected.[16]

Table 14. Summary of recreational use losses (May, 2009 dollars).

Measure of Loss	Recreational Fishing/Crabbing	Waterfowl Hunting	Pleasure Boating	Total
Affected trips	20,652	15,559	5,498	41,709
Raw lost value	$679,435	$401,228	$94,331	$1,174,994
Discount factor	1.123	1.123	1.123	1.123
Lost value	$762,762	$450,435	$105,900	$1,319,097[a]

[a] Numbers may not equal totals due to rounding.

The results in Table 14 are derived for the purpose of recovering funds in the amount of the total lost value. The funds will be used to implement projects that enhance recreational opportunities on the Delaware River, thus compensating lost value with future recreation benefits. This approach to damage assessment and restoration is known as "value to cost," because restoration projects are selected as preferred so that the cost of projects equals the value of losses. This approach is less preferred than the "value to value" approach, whereby the value of restoration projects is determined and projects are selected as preferred so that restored value is equivalent to lost value. Valuing restoration projects is more difficult than valuing recreational losses due to the limited availability of previous research on the topic, and it was determined that the expense of a restoration valuation exercise was not warranted in this case. The Trustees believe that the monetary valuation obtained in the recreational use assessment will provide sufficient guidance in determining the appropriate compensatory restoration.

[16] The discount factor of 1.104 was used for this analysis to account for the passage of time between the losses from the spill and the date compensation is received. The assumed date for compensation is 1 November 2008, and the midpoint of 2005 is used as the date for recreational losses.

4.4 - Summary of Injuries

A summary of the injury assessment results, as described in the preceding sections, is provided in Table 15.

Table 15. Summary of injury estimates.

		Injury Estimate	
Resource Injury Category	**Resource**	**Acres or Trips**	**DSAYs[a] or Value**
Shoreline	Seawalls	59.38	30.32
	Sand/mud substrate	1,415.83	1,117.24
	Coarse substrate	137.23	126.84
	Marsh	116.47	60.2
	Tributaries	1,899.23	523.53
Aquatic	Subtidal benthic habitat	412	97
Bird and Wildlife	Dabbling ducks, diving ducks, diving birds, gulls, shorebirds, wading birds, swans/geese, kingfishers	20,027.5 kg of birds lost	
Recreation	Lost and diminished value trips	41,709 trips	$1,319,097

[a]DSAYs for shoreline and aquatic injuries are not equivalent across resource categories.

CHAPTER 5.0 - Restoration Planning Process and Analysis of Alternatives

The goal of restoration planning under OPA is to identify actions appropriate to restore, replace, or acquire natural resources or services equivalent to those injured by oil spills to the condition that they would have been if the incident had not occurred. This goal is achieved through the restoration, rehabilitation, replacement, or acquisition of equivalent natural resources and/or services (33 U.S.C. §2706(b)). The development and consideration of alternatives also is appropriate to fulfill the intent of NEPA. NEPA requires consideration of a No Action alternative as well as identification of appropriate alternative approaches that would fulfill the purpose and need for the action.

The restoration planning process may involve two components: primary restoration and compensatory restoration. Primary restoration actions are designed to assist or accelerate the return of a resource, including its services, to pre-injury or baseline conditions. In contrast, compensatory restoration actions serve to compensate for the interim loss of resource services due to injury, pending the return of the resource to baseline conditions or service levels. The scale of a compensatory restoration project depends on the nature, extent, severity, and duration of the resource injury. Primary restoration actions that speed resource recovery reduce interim losses, as well as the amount of restoration required to compensate for those losses.

In this instance, response actions undertaken following the discharge are expected to protect natural resources from further or future harm and to allow resources to return to pre-injury or baseline conditions within a reasonable period of time. Under these circumstances, it is unnecessary for the Trustees to consider or plan for primary restoration actions. Accordingly, this final Plan focuses only on defining appropriate compensatory restoration actions.

5.1 - Restoration Strategy

In accordance with the NRDA regulations, the Trustees identified and evaluated a wide range of project alternatives capable of restoring ecological services comparable to those lost due to injury to shoreline, aquatic, birds and wildlife, and recreational resources at or in the vicinity of the discharge. These alternatives were identified by first searching for potential projects within the watershed, including a public request for project proposals solicited via a letter to non-governmental organizations, and local and state stakeholders. The project alternatives were subject to screening to narrow to a field of reasonable project alternatives considered in this final Plan. The “No Action” alternative was also included for consideration, as required by NEPA and the OPA NRDA regulations. These reasonable alternatives were then evaluated more carefully by the Trustees based on the criteria outlined in Section 5.2. These criteria include consideration of whether sufficient information was available to assess the environmental consequences of the proposed action and support a comparison of alternatives in accordance with the requirements of NEPA. Sections 5.4 and 5.5 of this final RP/EA outlines each alternative, the results of the Trustees’ evaluation of proposed projects, and the environmental consequences of the restoration actions considered for implementation. Specifically, Section 5.6 summarizes the Trustees’ preferred projects for compensatory restoration.

When developing and screening alternatives, Trustees identified their preferred strategy for effecting restoration to compensate for natural resource and service losses under this plan. For injuries to ecological resources, the Trustees employed a resource-to-resource scaling methodology, where restoration actions provide natural resources and/or services of the same type and quantity as those lost. In contrast, projects to compensate for lost recreational use were scaled to a total dollar amount estimated as the value lost by the public who were unable to recreate because of the spill and/or experienced a reduction in trip quality.

Among the preferred restoration proposals are a variety of habitat restoration projects intended to compensate for bird losses caused by the spill. The majority of bird losses were to migratory species. For that reason, bird scaling calculations are based on the incremental forage expected to be provided by these near spill-area projects and their corresponding ability to support the numbers and types of birds needed to compensate for quantified bird losses (accounting for trophic transfer efficiencies). It would be inappropriate to also credit these projects against spill-related habitat losses since such an approach would double count project benefits (e.g., incremental productivity). In addition, while it is reasonable to expect that mammals, amphibians, reptiles, and/or other biota would derive some benefit from restoration projects intended to compensate for bird losses, spill-related injuries to these categories of biota were not quantified. The Trustees made the reasonable, simplifying assumption that spill-related losses and restoration gains offset each other, so adjustments to scaling calculations were not deemed to be warranted.

5.2 - Restoration Evaluation Criteria

All of the potential restoration project alternatives identified by the Trustees were reviewed to narrow the list of potential projects and focus information-gathering efforts on the most likely alternatives to meet the purpose and need for action (see Section 2.0). The Trustees considered 61 different restoration ideas ranging from fish blockage removals, land acquisition, wetland restoration, shellfish restoration, and recreational enhancements that are potentially capable of providing compensatory restoration for injuries resulting from the *Athos* oil spill. These were provided to the Trustees by appropriate federal and state officials, members of the public, and non-governmental organizations familiar with the Delaware River system.[17]

[17] Potential restoration project ideas were solicited from the general public, including: the Partnership for the Delaware Estuary, Delaware Riverkeeper Network, Pennsylvania Environmental Council, Philadelphia Water Department - Office of Watersheds, DelCo Anglers, Pennsylvania B.A.S.S. Federation, Schuylkill Center for Environmental Education, Academy of Natural Sciences of Philadelphia, Darby Creek Valley Association, Fairmount Park Commission, Audubon Pennsylvania, The Nature Conservancy – Pennsylvania Chapter, The Nature Conservancy – Delaware Chapter, Brandywine Conservancy, New Jersey Green Acres Program, American Rivers, Trout Unlimited, Fairmount Park Commission, American Littoral Society, Pennypack Ecological Restoration Trust, Ducks Unlimited, Schuylkill Action Network, Delaware River Basin Commission, New Jersey Marine Science Consortium, Delaware Audubon, Delaware Nature Society, Delaware Wild Lands, Inc., Delmarva Ornithological Society, Ducks Unlimited – Mid-Atlantic Field Office.

The initial Tier 1 screening criteria that applied to all proposed projects were: (1) does the project have the potential to result in a quantifiable increase in one or more of the injured resources (i.e., nexus to the injury); and (2) is there sufficient information about the project available to allow evaluation with the OPA and NEPA criteria and enable implementation within 12 months of the finalization of the Restoration Plan. The project lists, as well as the result of the application of the Tier 1 screening criteria appear below in Table 16:

Table 16. Tier 1. List of Restoration Ideas and Alternatives Considered by the Trustees.

Project	Project Description	Does the project have the potential to result in a quantifiable increase in one or more of the injured resources (i.e., nexus to injury)?	Is there sufficient information about the project (planning, etc.) available to (a) evaluate the project and (b) enable implementation within the next 12 months?	Retained for Detailed Analysis
Augustine Boat Ramp	Address sedimentation issue by reengineering breakwater.	Yes	Yes	Yes
Benthic Mapping	Map benthic habitat resources to increase understanding of the Delaware Bay and its living marine resources, including shellfish.	No	Yes	No
Blackbird Reserve	Restoration of agricultural lands into a combination of forested areas, shallow wetland ponds, wildlife pastures, and agricultural food plots.	Yes	Yes	Yes
Boeing Facility	Crum Creek and Little Crum Creek are enclosed underneath parking lots at Boeing. Day lighting the streams and providing fringing tidal wetlands is a possibility.	Yes	No	No
Brandywine Creek Shad Restoration Project (Dam Removal)	Dam removal opportunities exist along the Brandywine Creek for restoration of anadromous fish habitats. The Brandywine Creek Conservancy, in partnership with NOAA and NFWF has prepared a feasibility study for fish passage at 13 of the blockages along the creek. DNREC will be removing three of the 13 dams this year.	Yes	Yes	Yes
Camden Greenways	There are many projects on the Cooper and Newton Rivers within the City of Camden (tidally influenced) and up-river in the non tidal portions. Projects could focus on stormwater management, public access, and habitat enhancement. Another project could include erosion and sediment control or invasive plant removal at Farnham Park (Camden Greenway).	Yes	No	No
Chester Creek Dam Removal	Remove a series of small, low-head dams on the Chester Creek which significantly block fish passage for migratory species.	Yes	No	No
Christina Boat Ramp: Fishing Pier and Public Access Restoration	Restore boat ramp, fishing pier, and public access at the 7th Street ramp, located on the Christina River, just above the Brandywine.	Yes	Yes	Yes
Daniels Pond Repair and Restoration (Cedar Swamp)	This project would repair and restore a 4.7 acre pond in the Cedar Swamp Wildlife Area. Muskrat burrowing damage to an existing dike has weakened the dike sufficiently to have caused a breach during a severe storm event. Repairs would involve installing a water control structure to double as an emergency outflow, repairing the dike breach, and burying chain link fence along the toe of the dike to deter future muskrat burrowing damage.	No	Yes	No

Project	Project Description	Does the project have the potential to result in a quantifiable increase in one or more of the injured resources (i.e., nexus to injury)?	Is there sufficient information about the project (planning, etc.) available to (a) evaluate the project and (b) enable implementation within the next 12 months?	Retained for Detailed Analysis
Darby Creek Dam Removal and Stream Restoration	The creek currently has three low dams and a remnant bridge pier that interfere with stream flow and the movement of anadromous fish. The project will remove the four obstructions and implement in-stream and riparian restoration for up to 1,000 feet upstream and downstream of the current obstructions. Floodplain restoration projects are also planned for a 10-acre site adjacent to the Kent Park dam.	Yes	Yes	Yes
Delaware Bay Shoreline Restoration Project	Shoreline habitat debris removal and restoration project. This project would enhance and re-establish breeding habitat for horseshoe crabs along the shoreline of the Delaware Bay.	Yes	No	No
Delaware City Wetland Enhancement	Eight acres in Delaware City along Branch Canal. Project would involve excavation of ponds and ditches to improve heterogeneity of marsh system, *Phragmites* control, installation of a water control structure, and reestablishment of an existing berm that has eroded and is causing flooding of a portion of Delaware City.	Yes	No	No
Delaware River Shoreline Restoration/ Acquisition Projects	Three potential projects in the Port Penn area ranging in size 10 to 30 acres. Restoration technique would be primarily habitat enhancement (shoreline erosion control and *Phragmites* control) and acquisition.	Yes	No	No
Delaware Watershed Open Space Project (General Project Type)	Acquisition of high-quality habitats and environmentally-sensitive open space lands throughout the Delaware Watershed. Habitats to purchase, acquire, and protect could include riparian zones lands, floodplains, streambanks, river-reaches, marshes/wetlands, and other associated finfish and shellfish habitats. Options for acquisition include partnering with The Nature Conservancy, Partnership for the Delaware Estuary, and others.	Yes	No	No
Delaware Tributary Mussel Restoration	The goal of this project was to restock two species of mussels that appear to have been extirpated from the Brandywine River near Wilmington, Delaware.	Yes	Yes	Yes
Denton Property - Ecological Restoration	31-acre parcel along the Delaware River. A portion of this site was formally used as a landfill.	Yes	No	No
Dravo Marsh Restoration Project	This project consists of acquisition, restoration and enhancement of degraded, emergent tidal freshwater wetland habitat and upland scrub/shrub-forested buffer habitat on the Christina River in Wilmington, Delaware known as the Old Wilmington (Dravo) Marsh.	Yes	Yes	Yes

Project	Project Description	Does the project have the potential to result in a quantifiable increase in one or more of the injured resources (i.e., nexus to injury)?	Is there sufficient information about the project (planning, etc.) available to (a) evaluate the project and (b) enable implementation within the next 12 months?	Retained for Detailed Analysis
Fairmount Fish Ladder Rehabilitation	Repair existing, or install new, fish ladder at Fairmount Dam. Currently a degraded fish ladder structure prevents many migratory fish from passing the dam successfully to access upstream spawning habitats. This project is a priority of the USACE.	Yes	Yes	Yes
Floodplain Restoration	Restoring floodplain areas on the main stem and along tributary streams – including buyouts of existing structures, removal of fill, and reforestation.	Yes	No	No
Fox Point State Park (Edgemoor, Delaware) - Shoreline Restoration	Restoration can be performed at Fox Point proper for invasive species, shoreline stabilization, tidal wetlands, etc.	Yes	Yes	Yes
Freshwater Tidal Marsh Enhancement and/or Restoration	Particular focus on tidal tributaries in the upper estuary (e.g., Ridley, Chester, Woodberry, Mantua Creeks; Schuylkill, Brandywine, Christina Rivers).	Yes	No	No
Gandy's Beach Acquisition and Preservation	Acquisition/preservation of a large tract of high quality habitat along the Delaware River which could provide habitat for birds and intertidal habitat for marine resources.	Yes	Yes	Yes
Grass Dale Wetlands Ecological Restoration	Control of invasive plant species and maintenance of walking trail.	Yes	Yes	Yes
Green Acres Program Habitat Acquisition Program	The NJDEP has a Green Acres Program that actively acquires land parcels for preservation and possible future restoration projects. Desired land parcels were assumed to be located in areas that would be proximal to the spill and/or Delaware Bay, provide habitat or restoration potential, and could be on or near tidal waters.	Yes	No	No
Habitat Restoration: John Heinz NWR	Restore wetland habitat within the John Heinz National Wildlife Refuge.	Yes	Yes	Yes
Horseshoe Crab Fishery Buyout	Buyout the horseshoe crab fishery to restore populations of horseshoe crabs and the avian species which feed upon their eggs.	Yes	No	No
Hydrological Restoration at Repaupo Creek	Repaupo Creek is currently bermed and gated from the flow of the tide. The berm and the tide gate could be removed to restore tidal flow to the creek and surrounding wetlands. The result of removing the obstructions to the tide would result in a large increase in freshwater wetlands. Tidal freshwater wetlands are critically important in this part of New Jersey and would result in an increase in habitat value for waterfowl, wading birds, fish, raptor foraging, and other injured resources.	Yes	No	No

Project	Project Description	Does the project have the potential to result in a quantifiable increase in one or more of the injured resources (i.e., nexus to injury)?	Is there sufficient information about the project (planning, etc.) available to (a) evaluate the project and (b) enable implementation within the next 12 months?	Retained for Detailed Analysis
Kelly Island Shorebird and Horseshoe Crab Project	Restoration, enhancement, and protection of critical horseshoe crab and shorebird nursery, foraging, and breeding habitats on Kelly Island. Restoration techniques could include shoreline protection, marine debris removal, beach enhancement, shoreline restoration, public access enhancement, and creation of buffer zones.	Yes	Yes	Yes
Land Acquisition - Philadelphia Area	Acquire one or more of four parcels along the west side of the Delaware River in Philadelphia (Milnor St., 3101 E. Hedley, 3100 Orthodox, 500 Richmond St.).	Yes	Yes	Yes
Lardner's Point Riparian Restoration	Restore habitat and create a park on the 4.5 acre riverfront site at the former coal holding facility for the Lardner's Point Pump Station.	Yes	Yes	Yes
Little Tinicum Island Marsh Restoration	Restore tidal wetland areas previously filled with dredge spoil. Up to 12 feet of filled spoil exists in parts of this former wetland area.	Yes	Yes	Yes
Mad Horse Creek Habitat Restoration	Habitat restoration on state owned property along Mad Horse Creek (N.J.).	Yes	Yes	Yes
Mannington Meadows Wetland Restoration	Mannington Meadow is a brackish estuary located on the Salem River drainage, Salem County, New Jersey. Potential exists to restore this degraded marsh to a functional, tidal brackish, and freshwater ecosystem. Keys to this restoration include increasing the incoming freshwater flow from Salem River and reducing the coverage of *Phragmites* in these degraded wetlands.	Yes	Yes	Yes
Milford Neck Tidal Marsh Restoration Project	Salt marsh hydrology restoration - restoring natural drainage to those marshes previously ditched for mosquito control. There is at least one area near Milford Neck in Delaware.	Yes	Yes	Yes
Misc. Boat Ramps	The NJDEP Fish and Wildlife Program has a list of eight possible boat launch projects. At this time many of the projects are still in the planning/feasibility stage. Most of these locations are also in the lower Delaware River/Delaware Bay region.	Yes	No	No
Misipillion Horseshoe Crab and Shorebird Project: Beach Improvements/Dune Stabilization	Restoration and enhancement of horseshoe crab and shorebird habitats on the Misipillion River shoreline, including beach restoration, dune stabilization, marine debris removal, and shoreline protection.	Yes	No	No
Mt. Holly Fish Passage	Remove a large dam (previously used for power generation) that blocks diadromous fish passage on the Rancocas Creek. Options include dam removal and/or fish passage.	Yes	No	No

Project	Project Description	Does the project have the potential to result in a quantifiable increase in one or more of the injured resources (i.e., nexus to injury)?	Is there sufficient information about the project (planning, etc.) available to (a) evaluate the project and (b) enable implementation within the next 12 months?	Retained for Detailed Analysis
New Camden Park Education Project	Create tidal wetlands to filter stormwater runoff, provide outdoor/hands on education, wildlife habitat, and access for new greenways trails.	Yes	No	No
Oyster Monitoring: Bayshore Discovery Project	The Bayshore Discovery Project, a non-profit conservation and education organization in Southern N.J., in partnership with the NOAA Restoration Center and Rutgers Universities Haskins Shellfish Laboratory, proposes to monitor oysters in the Delaware Bay (Bivalve, New Jersey). The partnership with Rutgers allows for in-depth restoration monitoring and research, and the Discovery project currently has access to a broad range of volunteers and boat vessels in which to implement oyster reef restoration.	No	Yes	No
Oyster Reef Restoration	Create oyster reef in Delaware Bay based on NJDEP Multiphase shell planting program.	Yes	Yes	Yes
P.O.R.T.S. – Oyster Reef Education Project	Rutgers University is proposing to develop curriculum and education projects to enhance the public's knowledge of the importance and dynamics of oyster reefs and oyster populations. In addition, opportunities exist to enhance an existing oyster gardening program in the Bay.	No	Yes	No
Pennypack Creek Dam Removal and Habitat Restoration	Remove dams and enhance in-stream, riparian, shoreline and streambank habitat on Pennypack Creek in Pennsylvania. Examples include in-stream fish enhancements, such as resting pools, rock vanes, cover enhancements, and riffles, and riparian restorations such as streambank stabilization, plantings, and shoreline softening projects.	Yes	No	No
Perkiomen Creek Dam Removal and Fish Passage Restorations	A series of small low-head dams significantly blocks migratory fish passage along the creek. A total of four dams are in need of removal.	Yes	No	No
Philadelphia Sludge Lagoon Restoration	Tidal wetland restoration at the old sludge lagoon (not used at present) near Philadelphia's Southwest STP.	Yes	No	No
Phragmites Control	Remove *Phragmites*, an invasive plant species, from sites along the Delaware River and its tributaries.	Yes	Yes	Yes
Prime Hook NWR (Horseshoe Crab/Avian Restoration)	Purchase 64 acres of Fowlers Beach, adjacent to Prime Hook NWR. It is the last undeveloped beach stretch in the area and is used by horseshoe crabs, red knots, and piping plovers. The Refuge owns the property around these parcels and some of the owners would like to develop their property.	Yes	Yes	Yes

Project	Project Description	Does the project have the potential to result in a quantifiable increase in one or more of the injured resources (i.e., nexus to injury)?	Is there sufficient information about the project (planning, etc.) available to (a) evaluate the project and (b) enable implementation within the next 12 months?	Retained for Detailed Analysis
Saddlers Woods	Saddlers Woods (Haddon Twp., New Jersey): This old growth forest is in desperate need of stormwater management projects, including bank stabilization, created wetlands, swales, etc.	Yes	No	No
Salem County, New Jersey Wetland Restoration	Acquire and/or restore a large (300+ acre) area bordered by AID, the Killcohook Site, and the Delaware River. This land is under multiple ownership The land use is currently non-production agriculture.	Yes	No	No
Shellfish Restoration in the Middle and Upper Delaware Estuary	Use of brackish and freshwater species of mussels or clams to enhance water quality and essential habitat and food for fish and crabs; in addition, opportunities exist to utilize shellfish and their habitats to control erosion in tidal marsh areas.	Yes	Yes	Yes
Shorebirds Stewards & Survey/Gull Exclusion	Train stewards to patrol the beaches of Delaware Bay during the peak migration period to ensure that nesting and foraging shorebirds are not disturbed; perform shorebird surveys from the water to reduce human disturbance and achieve greater integrity of data when used with data from aerial surveys; and install gull exclusions to further address the impact of gull predation on horseshoe crab eggs.	Yes	Yes	Yes
Stipson's Island Mitigation Bank	Tidal and freshwater wetland bank in southern New Jersey.	Yes	Yes	Yes
Stow Creek Boat Ramp	Improve Stow Creek boat ramp to enhance recreational use.	Yes	Yes	Yes
Stow Creek Wetland Enhancement	This site consists of a large, unused agriculture field that is available for restoration to its former tidal marsh condition. Activities could include restoring/enhancing two individual marshes on each edge of the site, restoring/creating riparian buffers, and installing a public access boat ramp on the site.	Yes	No	No
Streambank Stabilization	Streambank stabilization, floodplain, and in-stream restoration in Easton, Pennsylvania.	Yes	No	No
Sturgeon Habitat Restoration	Restore sturgeon spawning habitat (creation of hard bottom, cobble habitat in the mainstem Delaware River, N.J.).	Yes	No	No
Supawna Meadows NWR	General habitat acquisition and restoration.	Yes	No	No
Thousand Acres/ Appoquinimink Wetland Enhancement	Tidal wetland restoration/acquisition projects – three projects ranging in size from 233 to 56 acres in the Thousand Acres/Appoquinimink Watershed. Restoration technique would be primarily habitat enhancement/*Phragmites* control and acquisition.	Yes	Yes	Yes
Tinicum Island Recreational Trail	Enhance recreational trail on Tinicum Island.	Yes	Yes	Yes

Project	Project Description	Does the project have the potential to result in a quantifiable increase in one or more of the injured resources (i.e., nexus to injury)?	Is there sufficient information about the project (planning, etc.) available to (a) evaluate the project and (b) enable implementation within the next 12 months?	Retained for Detailed Analysis
Tinicum Township Salt Marsh Restoration	The Township has acquired property just downstream from the airport runways, adjacent to river tidal marsh (former Westinghouse Property), that has the potential for wetland creation or enhancement. At present, it appears to be historical fill in tidal wetlands with some depression wetlands on top.	Yes	No	No
Trenton Fishing Wharf	Opportunities exist to enhance the public access and fishing piers along the Delaware River in Trenton, New Jersey.	Yes	Yes	Yes
University of Delaware Oyster Survey	This project is a reconnaissance of tributaries in the Lower Delaware Bay with the goals of (1) locating live oyster bars in the tributaries, (2) determining whether recruitment or "set" has occurred in recent years, and (3) characterizing water quality parameters at these bars. Moreover, this is an initial assessment of tributary bars as potential "refuge" and seed areas for oyster restoration in the Delaware Bay.	No	Yes	No

Of the 61 project ideas considered by the Trustees, 29 met the initial screening requirements and were brought forward for a closer evaluation, represented as Tier 2 Evaluation. Table 17 presents the second tier of project screening for the 29 alternatives that met the criteria of the first tier. These projects were screened to narrow the list of alternatives and focus information-gathering efforts on the most feasible alternatives. The criteria applied to all proposed projects were: (1) OPA regulations (15 CFR § 990.54) , and (2) "Factors to evaluate proposed restoration alternatives under the Oil Pollution Act, Delaware River/M/T *Athos I* oil spill" (*Athos* Trustee Council 2006). Projects that met these criteria were subject to a closer evaluation.

The OPA regulations (15 CFR § 990.54) identify the following six criteria that were used to evaluate the 29 alternatives:

A) Cost to carry out the alternative;
B) Extent to which each alternative is expected to meet the Trustees' goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses;
C) Likelihood of success of each alternative;
D) Extent to which each alternative will prevent future injury as a result of the incident and avoid collateral injury as a result of implementing the alternative;
E) Extent to which each alternative benefits more than one natural resource and/or service; and
F) Effect of each alternative on public health and safety.

In addition to the six OPA criteria, the Trustees adopted several other factors to assess the appropriateness of proposed restoration alternatives. These are listed below, and described in the document "Factors to evaluate proposed restoration alternatives under the Oil Pollution Act, Delaware River/M/T *Athos I* oil spill" (*Athos* Trustee Council 2006). In addition to the items below, proximity to the oil spill site was considered, pursuant to Criterion B for OPA (above) regarding compensation for interim losses.

A) Compliance with applicable federal and state laws and policies;
B) Possibility for integration with existing management programs that are consistent with the Trustees' restoration goals under OPA;
C) Evaluation of the adjacent or nearby affecting land uses;
D) Site ownership;
E) Logistical considerations;
F) Consistency with local, regional, and national restoration goals and initiatives; and
G) Longevity of the project.

Based on the application of the evaluation criteria listed above, the list of potential restoration locations was narrowed down from the 29 potential restoration sites in Table 17 (Tier 2) to 14 action alternatives. This streamlined list provided a reasonable range of alternatives (Table 18) to meet the stated purpose and need.

Table 17. Tier 2. List of narrowed restoration projects.

Projects Determined from Tier 1	OPA Selection Criteria							Additional Trustee Selection Factors									
	Cost	Restores Injury Resources	Likelihood of Success	Avoids Additional Injury	Multiple Benefits	Public Health and Safety	TOTAL	Integration with Existing Programs	Adjacent/ Nearby Land Uses	Site Ownership	Logistics	Consistent with Established Goals and Objectives	Project Longevity	Long term O&M	TOTAL	Combined TOTAL	Recommended*
Augustine Boat Ramp	0	1	1	0	-1	1	2	1	1	2	2	2	2	1	11	13	Yes
Blackbird Reserve	2	2	2	2	1	1	10	2	2	2	2	2	2	-1	11	21	Yes
Brandywine Creek (multiple dams)	-1	1	0	2	2	1	5	1	1	2	2	1	1	2	10	15	Yes
Christina Boat Ramp, Fishing Pier, and Public Access	0	1	1	0	-1	1	2	0	0	0	0	-1	0	0	-1	1	No
Darby Creek Dam (multiple dams)	1	2	2	2	2	2	11	2	2	2	2	2	2	2	14	25	Yes
Delaware Tributary Mussel Restoration	0	1	1	1	2	1	6	1	1	1	1	1	1	-1	5	11	No
Dravo Marsh Restoration Project	0	1	2	2	2	1	8	1	1	2	1	1	2	1	9	17	Yes
Fairmount Fish Ladder Rehabilitation	2	1	2	2	2	1	10	1	1	1	1	1	1	1	7	17	Yes
Fox Point State Park (Edgemoor, Delaware) - Shoreline Restoration	0	2	0	0	2	1	5	1	1	1	1	1	1	1	7	12	No
Gandy's Beach Acquisition and Preservation	2	1	1	1	1	1	7	-1	1	1	0	-1	0	0	0	7	No
Grass Dale Wetlands Ecological Restoration	0	1	1	1	1	1	5	1	1	1	1	1	1	1	7	12	No
John Heinz National Wildlife Refuge	1	1	1	0	1	0	4	2	2	2	2	2	2	1	13	17	Yes
Kelly Island Shorebird and Horseshoe Crab Project	0	1	1	-1	1	1	3	1	1	1	1	1	1	1	7	10	No
Land Acquisition - Philadelphia Area	0	1	1	2	2	2	8	-1	-1	-1	0	-1	0	0	-4	4	No
Lardner's Point Riparian Restoration	1	2	2	2	2	2	11	2	2	2	2	2	2	-1	11	22	Yes
Mad Horse Wetland Restoration	1	2	2	2	2	2	11	2	2	2	2	2	2	-1	11	22	Yes
Mannington Meadows Wetland Restoration	0	1	1	0	1	1	4	0	1	0	1	1	1	1	5	9	No
Milford Neck Tidal Marsh Restoration Project	0	1	1	1	1	1	5	2	1	1	1	1	1	1	8	13	Yes
Oyster Reef Restoration	2	-1	1	2	2	1	7	2	1	2	2	2	2	-1	10	17	Yes
Phragmites Control	0	-1	-1	1	-1	-1	-3	-1	-1	1	0	-1	0	-1	-3	-6	No
Prime Hook NWR Acquisition (Horseshoe Crab/Avian Restoration)	-1	-1	2	2	2	1	5	1	-1	-1	0	-1	0	0	-2	3	No
Shellfish Restoration	1	2	1	1	2	1	8	2	1	1	2	2	1	-1	8	16	Yes

Projects Determined from Tier 1	OPA Selection Criteria							Additional Trustee Selection Factors									
	Cost	Restores Injury Resources	Likelihood of Success	Avoids Additional Injury	Multiple Benefits	Public health and safety	Total	Integration with Existing Programs	Adjacent /Nearby Land Uses	Site ownership	Logistics	Consistent With Established Goals and Objectives	Project Longevity	Long Term O&M	Total	Combined Total	Recommended*
Shorebirds Stewards & Survey/Gull Exclusion	0	0	0	0	0	0	0	0	1	1	1	1	0	1	5	5	No
Stipson's Island Mitigation Bank	0	-1	-1	1	1	1	1	-1	-1	-1	0	-1	-1	0	-5	-4	No
Stow Creek Boat Ramp	1	1	1	2	1	1	7	2	1	2	2	2	2	-1	10	17	Yes
Thousand Acres/Appoquinimink Wetland Enhancement	0	0	0	0	0	0	0	1	1	1	1	1	1	1	7	7	No
Tinicum Township Salt Marsh Restoration	0	1	1	1	1	1	5	1	1	1	1	1	1	-1	5	10	No
Tinicum Island Recreational Trail	1	1	2	2	1	1	8	2	1	2	2	2	2	1	12	20	Yes
Trenton Fishing Warf	0	0	0	0	0	0	0	0	0	1	0	1	1	1	4	4	No

* The projects with scores above 13 were recommended.

Scoring			Long Term O&M Scoring		
	2	highly likely		2	no maintenance
	1	likely		1	some maintenance required
	0	don't know		0	don’t know
	-1	not likely		-1	a lot of maintenance required

Out of the 29 restoration projects listed under Tier 2, 14 projects were identified, listed in Table 18, as the range of reasonable project alternatives for further evaluation. This evaluation is provided in Section 5.4, below. The Tier 2 Long Term O&M scoring was recalculated from the Draft DARP/EA, which also resulted in changes in scoring. These scoring changes did not result in alterations to the list of projects that were put forward as reasonable project alternatives with the exception of the Delaware Tributary Mussel Restoration, which fell out of the alternatives list. This project was not chosen to move forward in the Draft DARP though since it was not based on proven, quantified restoration techniques within the Delaware system; it is more of a pilot-scale research effort that needs to be replicated many times (in-situ) and shown to provide successful results in order to determine the feasibility and likelihood of success as a compensatory restoration alternative.

Table 18. Reasonable Project Alternatives.

Projects Determined from Tier 2
Augustine Boat Ramp
Blackbird Reserve
Brandywine Creek (multiple dams)
Darby Creek Dam (multiple dams)
Dravo Marsh Restoration Project
Fairmount Fish Ladder Rehabilitation
John Heinz National Wildlife Refuge
Lardner's Point Riparian Restoration
Mad Horse Wetland Restoration
Milford Neck Tidal Marsh Restoration Project
Oyster Reef Restoration
Shellfish Restoration
Stow Creek Boat Ramp
Tinicum Island Recreational Trail

5.3 - Reasonable Project Alternatives

The following alternatives fall under the category of compensatory restoration actions. These projects would compensate for the interim loss of resource services due to injury, pending the return of the resource to baseline conditions or service levels.

5.3.1 - Alternative 1: No Action/Natural Recovery

Under the No Action alternative, no restoration, rehabilitation, replacement, or acquisition actions would occur. This alternative costs the least because no action would be taken. If selected, there would be no restoration or replacement of the lost resources and their services and the public would not be made whole for past injuries. The No Action Alternative could not be the preferred alternative since compensatory restoration is already required, but is retained for comparative purposes.

5.3.2 - Alternative 2: Augustine Boat Ramp

This project involves installing a rock jetty to the north of the Augustine boat ramp to prevent shoaling that is affecting the use and safety of this facility.

The existing boat ramp at Augustine Beach is located on the Delaware River in New Castle County, Delaware, about 1 mile south of Port Penn on Del. Route 9. The site, owned and maintained by DNREC, includes two handicapped-accessible ramps, two courtesy docks, and 100 parking spots, and is a popular site for boating, waterfowl hunting, and both commercial and recreational fishing.

5.3.3 - Alternative 3: Blackbird Reserve

This project entails enhancement and creation of pond, pasture, and avian agricultural food plot areas on agricultural lands within the state-owned Blackbird Reserve Wildlife Area in southern New Castle County, Delaware. In an effort to maintain habitat heterogeneity and provide wildlife habitat value, the Division of Fish and Wildlife proposes restoration of these agricultural lands into a combination of forested areas, shallow wetland ponds, wildlife pastures, and agricultural food plots. The latter three habitat types (shallow wetland ponds, pastures, and agricultural food plots) would be restored to provide suitable migratory goose wintering habitat.

5.3.4 - Alternative 4: Brandywine Creek (multiple dams)

Dam removal opportunities exist along Brandywine Creek near Wilmington, Delaware, for restoration of anadromous fish habitat. The Brandywine Creek Conservancy, in partnership with NOAA and the National Fish and Wildlife Foundation (Delaware Estuary Grants Program), has prepared a feasibility study for fish passage at 11 of the blockages along the creek. DNREC will be removing two of the 11 dams in 2009-2010. In addition, DuPont is investigating the potential of removing a dam at their experimental station. This tributary is extremely important to fisheries of the Delaware River and Estuary and would open up significant spawning and breeding habitat should passage be completed.

5.3.5 - Alternative 5: Darby Creek Dam (multiple dams)

This project involves the removal of three dams and a remnant bridge pier on Darby Creek in southeastern Pennsylvania, as well as associated in-stream and riparian restoration and enhancement. The obstructions currently interfere with anadromous fish passage, stream flow, and bank stability. The restoration plans include dam removal, removal of impounded sediments, regrading of in-stream and riparian areas, and shoreline vegetation.

5.3.6 - Alternative 6: Dravo Marsh Restoration Project

This project consists of acquisition, restoration, and enhancement of 190+ acres of degraded, emergent tidal freshwater wetland habitat, and 12 acres of upland scrub/shrub-forested buffer habitat on the Christina River in Wilmington, Delaware, known as the Old Wilmington (Dravo) Marsh.

5.3.7 - Alternative 7: Fairmount Fish Ladder Rehabilitation

The U.S. Army Corps of Engineers (USACE) has completed a project to restore the fish ladder at the Fairmount Dam along the Schuylkill River in Pennsylvania. A degraded fish ladder structure once prevented many migratory fish from passing the dam to access upstream spawning habitats. This project has been completed and migratory fish passage has been restored.

5.3.8 - Alternative 8: John Heinz National Wildlife Refuge (NWR)

At the John Heinz NWR, several former freshwater tidal wetlands have been used historically as dredge material disposal sites. This project involves excavating a series of channels and pools through one former tidal wetlands area to restore tidal connectivity and flushing. Removal of invasive vegetation (*Phragmites*) would be included, to enhance export of productivity to the tributary with the restored tidal flushing.

5.3.9 - Alternative 9: Lardner's Point Riparian Restoration

The goal of this project is the creation of functional riparian habitat at Lardner’s Point, adjacent to the Tacony-Palmyra Bridge in north Philadelphia. The 4-acre lot is a barren industrial site, consisting of a deteriorating concrete pad in the north section, with a dilapidated ferry dock and boat ramp on the eastern shoreline. The remainder of the site is vegetated with invasive species. The site is currently owned by the City of Philadelphia. The shoreline restoration includes demolishing existing structures, removing debris, importing fill material, grading the site to restore tidal inundation, and creating and planting intertidal marsh and wet meadow habitat.

5.3.10 - Alternative 10: Mad Horse Wetland Restoration

The proposed Mad Horse Creek restoration would manipulate nearly 200 acres of the Mad Horse Creek Wildlife Management Area to address injuries to shoreline and bird resources. NJDEP and NOAA are proposing a tidal wetland restoration project that would allow construction of *Spartina alterniflora* habitat at the appropriate elevations. Restoration would be accomplished through the removal of fill material to lower the marsh elevation and allow tidal inundation. Additional projects on the site include creation of wet meadow and grassland areas on former agricultural lands.

5.3.11 - Alternative 11: Milford Neck Tidal Marsh Restoration Project

This project involves restoring natural drainage to a marsh previously ditched for mosquito control near Milford Neck (Delaware). Specific restoration techniques for this project include restoration of tidal marsh hydrology, removal of constructed dikes to allow increased tidal exchange, and salt marsh restoration and enhancement.

5.3.12 - Alternative 12: Oyster Reef Restoration

Both NJDEP and DNREC propose projects to create and enhance oyster beds either by direct placement of shell for natural spat settlement or a two-step process whereby shell is placed in high spat recruitment areas and then moved to areas that exhibit higher spat growth and survival. These projects are intended to enhance subtidal productivity both through increased oyster populations and increased non-oyster biota associated with oyster bed habitat.

5.3.13 - Alternative 13: Shellfish Restoration

This project would rebuild and stabilize an eroded marsh edge with an intertidal, mussel-dominated community in a brackish region of the Delaware Estuary. This would be accomplished by installing hardened structures into the intertidal section of the marsh (concrete posts), to create additional surface area and habitat for restored mussels, allowing subsequent stabilization of the marsh edge and a mechanism to allow natural backfill of new sediment and marsh vegetation to existing, eroding marsh edge habitat.

5.3.14 - Alternative 14: Stow Creek Boat Ramp

This project would improve the Stow Creek boat ramp, a New Jersey–owned site located on the former Wosniak property in Stow Creek Township, Cumberland County, New Jersey. The existing ramp is extremely narrow and short, does not have a dock, and overall is in poor condition. The proposed improvements include widening and lengthening the ramp, removing the existing asphalt and replacing it with concrete, and constructing a small courtesy dock so that boats can be safely boarded, loaded, and unloaded.

5.3.15 - Alternative 15: Tinicum Island Recreational Trail

The proposed restoration project is to install a permanent trail, two observation decks and a “breakaway bridge” to cross a small wetland area on Tinicum Island, a former dredge spoil site. The trail would be a loop on the berm of the large spoil cell with a feeder trail that would allow viewing of the existing inlet wetland and lead to a permanent duck blind. Along the trail, invasive plant species would be controlled and revegetated with native plants to prevent further spread of invasives by recreational users.

5.4 - Identification and Environmental Consequences of the Restoration Alternatives

In accordance with NEPA, the No Action alternative and the reasonable alternatives are evaluated in this section and 5.5, respectively, to assess the potential significance of the actions on the human environment. Project-specific environmental consequences for each reasonable project are provided in this section. NEPA calls for consideration of potential, direct, indirect, and cumulative impacts when evaluating the significance of impacts.

5.4.1 - Evaluation of No Action/Natural Recovery Alternative

NEPA requires the Trustees to consider a "no action" alternative, and the OPA regulations require consideration of the natural recovery option. These alternative options are equivalent. Under this alternative, the Trustees would take no direct action to restore injured natural resources or compensate for lost services pending natural recovery. Instead, the Trustees would rely on natural processes for recovery of the injured natural resources. While natural recovery would occur over varying time scales for the injured resources, the interim losses suffered would not be compensated under the "no action" alternative.

The principal advantages of this approach are the ease of implementation and low cost. This approach relies on the capacity of ecosystems to "self-heal." OPA, however, clearly establishes Trustee responsibility to seek compensation for interim losses pending recovery of the natural resources. This responsibility cannot be addressed through a "no action" alternative. While the Trustees have determined that natural recovery is appropriate as primary restoration for injuries resulting from this incident, the "no action" alternative is rejected for compensatory restoration, as it does not meet the purpose and need for action. Losses were suffered and impacts continue during the period of recovery from this spill. Technically feasible, cost-effective alternatives exist to compensate for these losses.

5.4.2 - Evaluation and Environmental Consequences for Non-Preferred Restoration Alternatives

The Trustees identified 15 reasonable projects using the evaluation criteria presented in Section 5.2. Three of the restoration alternatives identified in Table 18—Brandywine Creek, Dravo Marsh Restoration, and Fairmount Fish Ladder Restoration—were dropped from further consideration during development of the draft DARP/EA when the Trustees were notified that each project had received alternate funding and was proceeding with plans to restore these areas. The projects listed below were found to meet the purpose and need for compensatory restoration, but were not preferred by the Trustees at the time the draft DARP/EA was finalized.

5.4.2.1 - Milford Neck Tidal Marsh Restoration Project

This project involves restoring natural drainage to a marsh previously ditched for mosquito control near Milford Neck (Delaware). Specific restoration techniques for this project include restoration of tidal marsh hydrology, removal of constructed dikes to allow increased tidal

exchange, and salt marsh restoration and enhancement. This project would have been suitable to compensate for shoreline and tributary injuries and injuries to birds and other wildlife.

Evaluation of Alternative
Of the projects that currently meet the purpose and need of the action—specifically, the portion of the injury able to be compensated via the implementation of a salt marsh restoration-related project—this alternative was deemed to have a high capacity to compensate for injuries to resources by providing multiple benefits. The project, however, is a less cost-effective approach to salt marsh restoration than the preferred project (in New Jersey) because the preferred alternative is closer in proximity to the spill and resulting injured resources. Therefore, the preferred salt marsh restoration project has a higher likelihood of success for restoration of natural resources injured as a result of the spill. Further, final details on the project area that would benefit from this alternative are still unknown. It would be necessary to establish and provide for future protection and management of the restored area in order for the public to realize the goal of restoration under this plan; the feasibility of providing such protections and future management techniques is not known at this time. Last, the project is less cost-effective than the preferred project due to the differences in project scales and the limited projected benefits as compared to the preferred restoration project. A larger project would need to be constructed to provide natural resource services equivalent to the preferred, further increasing project costs.

Ecological and Socioeconomic Impacts
Restoration of tidal marsh hydrology and enhancement of salt marshes would immediately re-establish more productive estuarine habitat in what is presently degraded, ditched, and diked remnant brackish marsh habitat. Implementation of this project would be expected to greatly increase and/or improve the overall ecology of wetlands in this area, and to greatly increase and/or improve the ecological services of the area of influence as nursery habitat for estuarine resources. The effects would benefit a wide variety of fish and wildlife, including those of recreational and commercial importance. Re-establishment of tidal hydrology and restoration of degraded salt marsh systems may disturb or displace resources within the footprint and immediate vicinity of the project area, but these impacts would be minimal, largely temporary, and result in no long-term effects other than the positive effects associated with the increased tidal hydrology and exchange resulting from the restoration project, as well as the enhanced salt marsh habitat available for natural resources injured by the spill.

Summary
This project was not proposed by the Trustees because other more cost-effective projects in closer proximity to the spill site were available. Therefore, it was difficult to assess its likelihood of success in restoring injuries resulting from this spill when compared to the preferred projects.

5.4.2.2 - Shellfish Restoration

This project would rebuild and stabilize an eroded marsh edge with an intertidal, mussel-dominated community in a brackish region of the Delaware Estuary. This would be accomplished by installing hardened structures into the intertidal section of the marsh (concrete posts), to create additional surface area and habitat for restored mussels, allowing subsequent

stabilization of the marsh edge and a mechanism to allow natural backfill of new sediment and marsh vegetation to existing, eroding marsh edge habitat. This project would have been suitable to compensate for aquatic injuries and injuries to birds and other wildlife by providing enhanced aquatic habitat and bird and wildlife foraging resources.

Evaluation of the Alternative
Of the projects that currently meet the purpose and need of the action, specifically, the portion of the injury able to be compensated via the implementation of a shellfish-related project, this alternative was deemed to have a high capacity to compensate for injuries to resources by providing multiple benefits. The project, however, is a less cost-effective approach to shellfish restoration than the preferred project because the infrastructure requirements make the project costs significantly higher at the onset. Further, the project area that would benefit from this alternative is privately owned. It would be necessary to establish and provide for future protection and management of the restored area in order for the public to realize the goal of restoration under this plan.

Ecological and Socioeconomic Impacts
Construction of a marsh platform at an appropriate elevation would immediately re-establish more productive estuarine habitat in what is presently an open water habitat. Although some services associated with open water habitat would be lost, implementation of this project would be expected to greatly increase and/or improve the overall ecology of wetlands in this area, and to greatly increase and/or improve the ecological services of the area of influence as nursery habitat for estuarine resources. The effects would benefit a wide variety of fish and wildlife, including those of recreational and commercial importance. Construction may disturb or displace resources within the footprint and immediate vicinity of the project area, but these impacts would be minimal, largely temporary, and result in no long-term effects other than the positive effects associated with the future functioning of the re-established marsh. At the end of the project life the area would return to open water, and with it, the return of existing resources and services.

Summary
This project was not proposed for further analyses because at the time alternatives were reviewed, insufficient information was available on the additional biomass provided by the project to scale it. Therefore, it was difficult to assess its likelihood of success in restoring injuries resulting from this spill.

5.4.3 - Evaluation and Environmental Consequences for Preferred Restoration Projects

As described below, six of the nine preferred restoration projects were scaled to restore ecological injuries; the remaining three were scaled to address recreational losses. Below is an analysis of each preferred restoration project. Accordingly, for each of these projects, an evaluation of the environmental consequences associated with the implementation of that project is provided here to assess the potential for significant impacts. Appendix 3 discusses potential impacts to the coastal zone and to endangered and threatened species. Consultation has occurred and compliance with the Coastal Zone Management Act and Section 7 of the Endangered Species Act has been met.

5.4.3.1 - Mad Horse Creek and Lardner's Point

Environmental Impacts
Marshes are widely recognized as providing numerous ecological functions, including habitat for juvenile finfish and shellfish, exporting detritus (energy source for the aquatic food web) into the estuary, and increasing water quality by filtering sediments and other pollutants from the water column. Marshes also provide many additional benefits such as storm surge protection, habitat for birds and mammals, and the potential for enhanced recreational use of the area through increases in the number of aquatic species.

Physical
A temporary increase in turbidity would be expected during construction, and would be timed (through best management practices (BMPs) and a time-of-year restriction) to occur during periods of reduced or non-critical usage by fisheries resources. In addition, sediment erosion controls such as turbidity curtains would be used to minimize or prevent sediments from entering the water column. These projects would not have long-term negative water quality impacts.

Biological
The projects would have no adverse long-term impacts on low marsh, transitional high marsh, wet meadow, or grassland vegetation. Excavation of these sites would increase the duration and frequency of tidal inundation and develop more favorable conditions for the spread of typical low marsh species (*Spartina alterniflora*, etc.), and produce benefits to the vegetative community as well as to wildlife with the excavation of wet meadows and the seeding of grasslands. The establishment of low marsh would radically alter the dominance of particular species but would not significantly affect the diversity of species. Positive impacts of the *Spartina alterniflora* dominated wetland include increased fisheries productivity and benefits to resident estuarine fish species such as mummichog and striped killifish. Fisheries-dependent avian species and guilds, such as wading birds, gulls, terns and ospreys, would also benefit. Increased production of small resident fish would provide positive off-site trophic benefits towards larger commercial and recreational fish species, such as bluefish and striped bass, which are dependent on small prey.

<u>Essential Fish Habitat</u>
The Mad Horse Creek restoration would occur in areas that are designated as Essential Fish Habitat (EFH), as determined by NMFS.

The Trustees conclude, based on informal consultation with the NOAA Habitat Conservation Officer (Appendix 6), that the Delaware Estuary does provide Essential Fish Habitat (EFH) as defined under the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.) for a number of marine species. Impacts would be avoided/mitigated by the use of BMPs, including installation of erosion mats, turbidity curtains, and the implementation of time-frame construction avoidance windows. No construction activities would occur directly adjacent to the river and creeks during potential periods of anadromous fish usage: March 1 through June 30.

While there may be some temporary, short-term impacts to EFH, there would not be any long-term adverse effects on Essential Fish Habitat. By restoring and enhancing wetlands and shoreline habitats, EFH would be enhanced by creating more and better habitat for prey species, forage and refuge habitat for juvenile managed species, and improving water quality. The Trustees believe that the restoration as proposed would not adversely impact, but should enhance the quality of the EFH in this area in the long-term (See informal EFH consultation: Appendix 6).

The Lardner's Point project would not occur in an area designated as Essential Fish Habitat (EFH), as determined by NMFS. There would be no adverse impacts to EFH.

Threatened and Endangered Species

No federally listed rare, threatened, or endangered species under the jurisdiction of NMFS are known to occur within the Mad Horse Creek project area, nor would any be disturbed by the additional actions necessary to carry out the preferred plan.

At Lardner's Point, the shortnose sturgeon (*Acipenser brevirostrum*) is a federally endangered species known to use the Delaware River as an over-wintering area (USFWS 2006). The Atlantic sturgeon is listed as endangered in Pennsylvania and Delaware (PA DCNRb; DNREC 2004) and may be present in the project area at certain times of the year. The Atlantic sturgeon is not a federally listed species; however, it is listed as a candidate species. Actions that may affect the migration and spawning of anadromous fish should be avoided from March 1 to June 30. Once project plans are fully developed, the lead Federal Agency would contact the NMFS Protected Resources Division to initiate coordination of this project.

The Trustees have completed consultations with USFWS for threatened and endangered species under their jurisdiction. Except for occasional transient species, no federally listed or proposed, threatened, or endangered species are known to occur within the project areas.

Socioeconomic

There would be no long-term socioeconomic impacts under the habitat restoration at Mad Horse Creek and Lardner's Point. Lands intended for restoration are government-owned, and the Trustees do not expect the project to have any significant long-term adverse economic impacts. Restoration at both sites would, however, provide lasting socioeconomic benefits to the surrounding community by enhancing aesthetic and scenic qualities. Following construction, Lardner's Point would become part of the larger proposed North Delaware Riverfront Greenway envisioned to encompass an approximately eleven-mile trail system along the Delaware River through Philadelphia, Pennsylvania. This project would enhance recreational fishing opportunities that currently exist on-site.

Evaluation

The identified projects are consistent with the Trustees' evaluation criteria, and restore the same or similar types of injury (i.e., wetland/intertidal habitat loss) in the same geographic area of the spill. Both projects would provide many of the same ecological services, are readily available, have a high likelihood of success, and can be scaled to quantified injuries. Marsh restoration and

enhancement is also consistent with state, federal, and local restoration goals established for the Delaware River.
Overall, these projects are a cost-effective method to address injuries to multiple habitat types along the Delaware River. Accounting for productivity differences between injured shoreline habitat, many of which are relatively small, into a single type of restoration project, provides cost and planning efficiencies. The estimated overall cost per acre for Mad Horse Creek is approximately $200,000, which is below per acre costs for nearby wetland restoration projects (e.g., Woodbridge Creek). Although the Lardner's Point per acre cost is above $600,000 per acre, the small size of the project (0.9 acres) and its location within the spill zone make it reasonable to include. The Lardner's Point shoreline restoration project would provide multiple benefits in the urban part of the river that was heavily impacted by the spill. These benefits include providing public access for a large population density to an ecologically restored site in the vicinity of the impacted area (although this project is not included as compensation for recreational losses); habitat restoration for estuarine fish, avian, and mammalian species; contributing to proposed networks of habitat restoration projects to provide connectivity between the upper and lower estuary; and localized water quality, sediment attenuation, and nutrient recycling benefits. Although the project cost per acre is somewhat high, the benefits of the project are also high due to the location and potentially significant improvement from baseline conditions.

The Trustees expect that any adverse effects for these projects would be temporary and minor, primarily associated with disturbance during construction activities, and that long-term impacts of the projects would be beneficial and contribute to restoration. Best Management Practices (BMPs) would be used in adherence to all federal, state, and local regulations.

5.4.3.2 - Darby Creek Dam Removal and John Heinz NWR Habitat Restoration

Environmental Impacts
Downstream of the lowest dam in Darby Creek, a variety of anadromous fish are found, including alewife, striped bass, and shad (NOAA 2003). Dam removal is expected to restore normal stream channel flows and facilitate passage of anadromous fish into the upper watershed. Creating channels and pools in the John Heinz NWR would return the area to its tidal wetland status, restoring habitat for many anadromous fish species.

Physical
A temporary increase in turbidity would be expected during construction of these projects, and would be timed (through BMPs and a time-of-year restriction) to occur during periods of reduced or non-critical usage by fisheries resources. These projects would have no long-term negative water quality impacts. Mitigation to prevent water-quality impacts would include the use of BMPs and sediment erosion controls such as turbidity curtains to minimize or prevent sediments from entering the water column and possible dredging of the sediment behind the dam prior to removal.

Biological
Restoration activities associated with these projects would not adversely impact any naturally occurring aquatic life. However, these projects would improve aquatic organism use within the

system. To comply with NMFS recommendations, no activity resulting in discharges would occur in or directly adjacent to the Delaware River or adjacent creeks during the period of potential fish migration or spawning: March 1 through June 30.

Essential Fish Habitat

The preferred restoration projects would not occur in an area designated as Essential Fish Habitat (EFH), as determined by NMFS (Appendix 6). There would be no adverse impacts to EFH.

Threatened and Endangered Species

No Federally listed rare, threatened, or endangered species under the jurisdiction of NMFS are known to occur within the proposed project area, nor would any be disturbed by the additional actions necessary to carry out the preferred plan.

The Trustees have completed consultation with USFWS for threatened and endangered species under their jurisdiction. Except for occasional transient species, no federally listed or proposed, threatened, or endangered species are known to occur within the proposed project area.

Socioeconomic

There would be no negative long-term socioeconomic impacts from habitat restoration on Darby Creek or the John Heinz NWR. Lands intended for restoration are government-owned, county–owned, or owned by SEPTA, and the Trustees do not expect the projects to have any significant long-term adverse economic impacts. Restoring these two sites should provide lasting socioeconomic benefits to the surrounding community by enhancing aesthetic and scenic qualities.

Evaluation

The Darby Creek dam removal project is consistent with the Trustees' evaluation criteria. It is cost-effective and restores the same type of habitat as that injured in tributaries in the same geographic area of the spill. Dam removal and tributary enhancement projects are also consistent with state, federal, and local restoration goals established for the upper estuary watershed of the Delaware River Basin. The project addresses objectives defined in conservation plans by both the Darby Creek Valley Association and the Delaware Estuary Program.

The habitat restoration project at John Heinz NWR is also consistent with the Trustees' evaluation criteria. It is cost-effective and restores the same or similar types of injury (i.e., tributary habitat) in the same geographic area of the spill. Marsh restoration and enhancement are also consistent with state, federal, and local restoration goals established for the Delaware River and for John Heinz NWR.

The Trustees expect that any adverse effects of these projects would be temporary and minor, primarily associated with disturbance during construction activities, and that long-term impacts of the projects would be beneficial and contribute to restoration. Best Management Practices (BMPs) would be used in adherence to all federal, state, and local regulations.

5.4.3.3 - Blackbird Reserve

Environmental Impacts
Wildlife species attracted to constructed shallow water ponds (depending on size) include waterfowl, songbirds, shorebirds, wading birds, amphibians, and reptiles, as well as some upland birds and mammals. These ponds, along with adjacent pasture lands, would provide feeding and roosting (resting) areas for waterfowl, specifically migratory geese.

Physical
A temporary increase in turbidity would be expected during construction, and would be timed (through BMPs and a time-of-year restriction) to occur during periods of reduced or non-critical usage by fisheries resources. In addition, sediment erosion controls such as turbidity curtains would be used to minimize or prevent sediments from entering the water column. These projects would not have long-term negative water quality impacts.

Biological
The open agricultural lands are to be restored to something other than "active agricultural" (i.e., farming). In an effort to maintain habitat heterogeneity and provide wildlife habitat values for all species currently utilizing the property, the Delaware Division of Fish and Wildlife proposes restoration of these agricultural lands as a combination of forested areas, shallow wetland ponds, wildlife pastures, and agricultural food plots. The latter three habitat types would be restored to provide suitable goose habitat. Existing lowland areas would be excavated to create two shallow wetland ponds surrounded by managed pastures designed to attract migratory geese. In addition, areas adjacent to the pastures would use agricultural practices to create wildlife food plots also designed to attract migrating geese.

Essential Fish Habitat (EFH) Impacts
The estuarine waters of Blackbird Creek have been designated as Essential Fish Habitat (EFH), as determined by NMFS for one or more species. Restoration activities at the site, which does not connect with Blackbird Creek, would have no effect on EFH and federally managed species. Since there are no proposed impacts of the project, further EFH consultations would not be necessary as required as part of the federal permit process.

(See informal EFH consultation: Appendix 6).

Threatened/Endangered Species and Critical Habitat Impacts
No federally listed rare, threatened, or endangered species under the jurisdiction of NMFS are known to occur within the proposed project area. ESA Consultation by NMFS is completed (see informal ESA consultation: Appendix 6). The Trustees have completed consultation with USFWS for threatened and endangered species under their jurisdiction. The federally threatened bog turtle (*Clemmys muhlenbergii*) may be present within the project area of Blackbird Reserve. Delaware Natural Heritage staff made a visit to the site in June 2008 and determined that there were no species of concern impacts with the project. The federally listed bog turtle is not in the area where construction would occur. Blackbird Reserve encompasses a vast area and sections of the Reserve include the bog turtle.

Socioeconomic
There would be no negative long-term socioeconomic impacts under the habitat restoration at Blackbird Reserve. Lands intended for restoration are government-owned, and the Trustees do not expect the project to have any significant long-term adverse economic impacts. Restoration of Blackbird Reserve, however, should provide lasting socioeconomic benefits to the surrounding community.

Evaluation
The identified projects are consistent with the Trustees' evaluation criteria, and result in restoration of the same or similar types of injury (i.e., bird biomass) in the same geographic area of the spill. The preferred projects provide many of the same ecological services, are readily available, have a high likelihood of success, and can be scaled to quantified injuries.

Migratory goose habitat creation on Blackbird Reserve is a cost-effective means of compensating for this injury. This project adds forage and resting areas desirable to geese to an important corridor for migratory waterfowl. The project is on state-owned land and would require minimal restoration, resulting in a cost-effective approach to addressing a portion of the goose injury.

The Trustees expect that any adverse effects would be temporary and minor, primarily associated with disturbance during construction activities, and that long-term impacts of the project would be beneficial and contribute to restoration. BMPs would be used in adherence to all federal, state, and local regulations.

5.4.3.4 - Oyster Restoration

Environmental Impacts
The preferred compensatory restoration project for restoring 4,637 kg of benthic biota is to create 4.5 acres of oyster reef in the Delaware River. The preferred compensatory restoration project for restoring 1,770 kg of piscivorous and omnivorous birds is to create 73.5 acres of oyster reef in the Delaware River. Both NJDEP and DNREC have established programs that create and enhance oyster beds either by direct placement of shell for natural spat settlement or a two-step process whereby shell is placed in high spat recruitment areas and then moved to areas that exhibit higher spat growth and survival.

Oysters are a keystone species in the Delaware Bay, providing a basis for a vast community of benthic organisms. Oysters and the reefs they create increase habitat and faunal diversity; through their high filtration capacity, they can also improve water quality. Thus, the preferred project would improve habitat quality; the shell planting would increase habitat complexity, and the increased filtration by a restored shellfish resource would improve water clarity.

Oysters are also a harvestable resource and economically important in the area. While oyster harvesting would not be allowed during the project's expected 5-year lifespan, these areas could provide broodstock populations. There are numerous commercial and recreational fisheries and supporting industries that could benefit from such enhanced production of naturally produced oysters and the reef structure.

Any impacts to existing habitats from project construction are expected to be temporary and minimal. Best Management Practices (BMPs) would be used in adherence to all federal, state and local regulations.

Physical
A temporary increase in turbidity is expected during construction, and would be timed (through BMPs and a time-of-year restriction) to occur during periods of reduced or non-critical usage by fisheries resources. Enhancing the oyster sites would create a temporary increase in suspended solids and turbidity, resulting in a reduction of water quality, and decrease in dissolved oxygen and light penetration of the adjacent water bodies during construction. This project is anticipated to have no long-term negative water quality impacts. Mitigation to prevent water-quality impacts would include the use of BMPs and sediment erosion control such as turbidity curtains to minimize or prevent sediments from entering the water column.

Biological
The project would have no adverse long-term impacts on low marsh or transitional high marsh vegetation.

Essential Fish Habitat (EFH) Impacts
This proposed restoration is occurring in areas that are designated as Essential Fish Habitat (EFH), as determined by NMFS. Based upon the nature of the work proposed, significant adverse impacts are not anticipated.

(See informal EFH consultation: Appendix 6).

Threatened/Endangered Species and Critical Habitat Impacts
Several species of sea turtles are seen throughout the area each year including threatened loggerhead (*Caretta caretta*), endangered Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), and green (*Chelonia mydas*) sea turtles, mainly during late spring, summer, and early fall when water temperatures are relatively warm. The Trustees have completed consultation with USFWS for threatened and endangered species under their jurisdiction. A known occurrence or potential habitat for the red knot (*Calidris canutus rufa*), a candidate species, is located on or near the project's impact area. The project would be implemented with a seasonal restriction on shell placement in the High Recruitment Zone from May 1 to June 15 to avoid disturbance of foraging birds during the migration season. Following these guidelines, this project is not likely to adversely affect federally listed or candidate species.

Socioeconomic
There would be no negative long-term socioeconomic impacts under the habitat restoration of the oyster reefs in Delaware Bay. The Trustees do not expect the project to have any significant long-term adverse economic impacts. Restoration of oyster reefs, however, should provide lasting socioeconomic benefits to the surrounding community.

Evaluation
This alternative is consistent with the Trustees' evaluation criteria. It is cost-effective, reasonably compensates for lost benthic biomass attributable to the *Athos* spill, and would be implemented

in the Delaware River in areas as close to spill-affected locations as conditions needed for oyster survival allow. Creating and enhancing oyster reefs is also a cost-effective, low risk restoration approach, and is consistent with existing federal, state, and local restoration goals for the Delaware River and Bay.[18] The likelihood of project success is high, as this effort would augment an existing, successful program for oyster reef creation.

The Trustees expect that any adverse effects would be temporary and minor, primarily associated with disturbance during construction activities, and that long-term impacts of the project would be beneficial and contribute to restoration.

5.4.3.5 - Stow Creek and Augustine Boat Ramps

Environmental Impacts
These boat ramp improvements would expand boating access to Stow Creek and the Delaware River and provide safer conditions for boaters in the Augustine Boat area. The Trustees believe that the project would help facilitate recreational boating opportunities of the type that were lost during the spill.

Physical
A temporary increase in turbidity would be expected during construction of these projects, and would be timed (through BMPs and a time-of-year restriction) to occur during periods of reduced or non-critical usage by fisheries resources. Mitigation to prevent water quality impacts would include the use of BMPs and sediment erosion controls such as turbidity curtains to minimize or prevent sediments from entering the water column. These projects would have no long-term negative water quality impacts.

Biological
The following may be present in the Stow Creek project area: resident, forage, and benthic species including winter flounder, summer flounder, windowpane, bay anchovy, bluefish, weakfish, river herring, striped bass, oysters, horseshoe crabs, and blue crabs. The following may be present in the Augustine project area: resident, forage and benthic species including summer flounder, bay anchovy, bluefish, weakfish, river herring, striped bass, and blue crabs. Restoration activities associated with these projects would not adversely impact aquatic organisms long-term.

Essential Fish Habitat
Both the Stow Creek and the Augustine projects would occur in areas that are designated as Essential Fish Habitat (EFH), as determined by NMFS. Based upon the nature of the work proposed at Stow Creek, there would be no significant adverse impacts to EFH. Further EFH consultations would not be needed as part of the federal permit process for Stow Creek.

[18] In 2001, representatives of Delaware and New Jersey—including both state regulatory agencies (DNREC/NJDEP), the Delaware River Basin Commission (DRBC), the Delaware Estuary Program, the Shellfish Councils for both states, USFWS, and interested citizens—began developing a bi-state oyster revitalization initiative.

Depending on the final design of the new stone jetty at the Augustine project site, additional consultation may be required as part of the federal permit process.

(See informal EFH consultation: Appendix 6).

Threatened and Endangered Species

No federally listed rare, threatened, or endangered species under the jurisdiction of NMFS are known to occur within the Stow Creek project area, nor would any be disturbed by the additional actions necessary to carry out the preferred plan.

Several species of sea turtles are seen throughout the area near the Augustine project site each year including threatened loggerhead (*Caretta caretta*), endangered Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), and green (*Chelonia mydas*) sea turtles, mainly during late spring, summer, and early fall when water temperatures are relatively warm. Shortnose sturgeon have been found in deeper water in the vicinity of the project but are not anticipated to be impacted by the project. The activities proposed would be covered under the no effect letter issued to the Philadelphia District Army Corps of Engineers in December 2004.

The Trustees have completed consultation with USFWS for threatened and endangered species under their jurisdiction. Except for occasional transient species, no federally listed or proposed, threatened, or endangered species are known to occur within the projects' impact areas.

Socioeconomic

The Stow Creek boat ramp and surrounding 186-acre property is owned by NJDEP. The ramp, despite its poor condition, is heavily used for fishing, hunting, and ecological tours. With proposed improvements, the boat ramp and courtesy dock would accommodate more hunters, fisherman, and ecological tourists. People who use the Stow Creek facility would be able to more safely launch their watercraft and it would be more compatible for people with disabilities.

These boat ramp improvements would expand boating access to Stow Creek and the Delaware River, and provide safer conditions for boaters. The Trustees believe that the projects would help facilitate recreational boating opportunities of the type lost during the spill.

Evaluation

The Trustees believe the projects would improve boating access on Stow Creek and the Delaware River by enhancing the utility and safety of the existing sites. As state-owned property, both ramps are open to all and serve residents throughout the region. There is limited boating access along the western shore of the Delaware River in much of the spill zone, so both sites are important for those wishing to access the spill zone from the south, as well as for emergency response needs. The Trustees expect that any adverse effects would be temporary and minor, primarily associated with disturbance during construction activities, and that long-term impacts of the project would be beneficial and contribute to restoration. Best Management Practices (BMPs) would be used in adherence to all federal, state, and local regulations.

5.4.3.6 - Little Tinicum Island Recreation Trail

Environmental Impacts
The preferred restoration project is to install a permanent trail, two observation decks, and a "breakaway bridge" to cross a small wet area. The trail would be a loop on the berm of the large spoil cell with a feeder trail that would allow viewing of the existing inlet wetland and lead to a permanent duck blind. Along the trail, invasive plant species would be controlled and revegetated with native plants to prevent further spread of invasives by recreationalists using the trail.

The project would provide recreational opportunities similar to those lost during the spill, including shoreline activities such as wildlife viewing, hiking, fishing, and picnicking.

Physical
A temporary increase in turbidity is expected during construction, and would be timed (through BMPs and a time-of-year restriction) to occur during periods of reduced or non-critical usage by fisheries resources. This project is anticipated to have no long-term negative water quality impacts. Mitigation to prevent water-quality impacts would include the use of BMPs and sediment erosion control such as turbidity curtains to minimize or prevent sediments from entering the water column.

Biological
The project would have no adverse long-term impacts on low marsh or transitional high marsh vegetation.

Essential Fish Habitat
The preferred restoration projects would not occur in an area designated as Essential Fish Habitat (EFH), as determined by NMFS (Appendix 6). There would be no adverse impacts to EFH.

(See informal EFH consultation: Appendix 6).

Threatened and Endangered Species
Endangered shortnose sturgeon may be present in the project area at certain times of the year. No work is proposed below the mean high water line of the Delaware River, therefore no coordination is needed regarding impacts to this species.

The Trustees have completed consultation with USFWS for threatened and endangered species under their jurisdiction and except for occasional transient species, no federally listed or proposed, threatened, or endangered species are known to occur within the project impact area.

Socioeconomic
There would be no negative long-term socioeconomic impacts under the trail creation at Little Tinicum Island. Lands intended for the trail are government-owned, and the Trustees do not expect the project to have any significant long-term adverse economic impacts. Restoration of the trails and habitat enhancement at Little Tinicum Island, however, should provide lasting socioeconomic benefits to the surrounding community.

Evaluation
The site's proximity to the spill zone in an area of limited shoreline access makes this a desirable restoration project. The project would encourage low-impact recreational activities of the kind lost during the spill. The creation of the trail may reduce ecological or personal harm resulting from trampling. Ecological impacts of the recreational improvements would be minimized. The Trustees expect that any adverse effects would be temporary and minor, primarily associated with disturbance during construction activities, and that long-term impacts of the project would be beneficial and contribute to restoration. Best Management Practices (BMPs) would be used in adherence to all federal, state, and local regulations.

5.4.4 - Cumulative Impacts

The environmental consequences in this section focus on direct and indirect effects of the alternatives. For this final RP/EA, a specific detailed assessment of cumulative impacts is not presented because the goal of the preferred restoration projects is to improve environmental conditions over time. The preference for certain projects is based on their capacity to compensate for prior injury and their likelihood of success (section 5.5). While some short-term impacts to resources are anticipated, the factors considered in this EA reduce the impact of the *Athos* spill on each of the four resource areas over the long-term, and therefore reduce the potential for cumulative significant impacts over time.

5.5 - Description of Preferred Restoration Projects

This section is organized by the category of injury to provide detailed project descriptions for each of the preferred restoration projects evaluated in section 5.4.3.

5.5.1 - Projects to Address Shoreline Resource Injuries

The Trustees determined that 1,729 acres of seawalls, sand/mud substrate, marsh, and coarse substrate, and 1,899 acres of tributaries were exposed to *Athos* oil. As described below, the Trustees identified two projects to compensate for the non-tributary losses and two projects to compensate for the tributary losses.

5.5.1.1 - Restoration of Non-Tributary Losses: Restoration of Freshwater Tidal Wetlands at Mad Horse Creek and Lardner's Point

The Trustees determined that 1,729 acres of shoreline habitat (primarily tidal flats) injured by the *Athos* spill resulted in a loss of approximately 1,335 DSAYs. However, the shoreline injury assessment (described in Section 4.3.1) did not address the ecological condition of the shoreline habitat at the time of injury; rather, it estimated the percentage of services present that were injured at given points in time. Therefore, based on the subtidal injury assessment (see Section 4.3.3), the baseline condition for shoreline resources in the mainstem of the Delaware River was set at a 10 percent injury level (i.e., 90 percent of potential "shoreline" services were present). Given that the majority of injury was to tidal flats, the subtidal value from the injury assessment

was deemed a reasonable proxy. The baseline service level results in a ten percent decrease in all DSAY values calculated for the mainstem shoreline resources.[19]

Table 19 displays the injury by habitat type. To compensate for this loss, the Trustees propose two habitat restoration projects: (1) restore 34.2 acres of brackish tidal wetland at Mad Horse Creek in New Jersey; and (2) restore 0.9 acre of freshwater tidal wetland/wet meadows at Lardner's Point in Pennsylvania. Both projects are located on the Delaware River, with Lardner's Point being directly exposed to oil from the spill (Figure 8).

Table 19. Non-tributary shoreline injury by habitat type.

Habitat type	Description	Acres	Relative DSAYs	Adjusted DSAYs
Marsh	Brackish and freshwater marsh	116	60	54
Sand/Mud substrates	Mixed sand/gravel beaches, natural banks	36	35	32
Lower Intertidal Zone		83	51	46
Tidal Flats	Mud and sand flats adjacent to beaches, banks, and marshes	1,298	1,032	929
Coarse Substrates	Rip-rap	137	127	114
Seawalls	Exposed man-made structures	59	30	27

Project Description - Mad Horse Creek

The Mad Horse Creek restoration would manipulate nearly 200 acres of the Mad Horse Creek Wildlife Management Area to address injuries to shoreline and bird resources. The Mad Horse Creek Wildlife Management area located in Lower Alloway Creek Township, Salem County, New Jersey, is owned by the State of New Jersey and contains salt marshes, transitional wetlands (*Phragmites* dominant), agricultural lands, and associated buildings. Past agricultural practices on this property included altering and filling the brackish marsh fringe.

NJDEP and NOAA are proposing to conduct a tidal wetland restoration project to allow construction of *Spartina alterniflora* habitat at the appropriate elevations. Restoration would be accomplished through the removal of fill material to lower the marsh elevation and allow tidal inundation. A more detailed description of the Mad Horse Creek site is provided in Section 5.5.3.

The State of New Jersey would serve as the Lead Implementing Trustee (LIT), with Trustee Council oversight.

[19] For example, a 50 percent service loss reported in the injury assessment will be evaluated as a 45 percent service loss (50% loss * 90% services present).

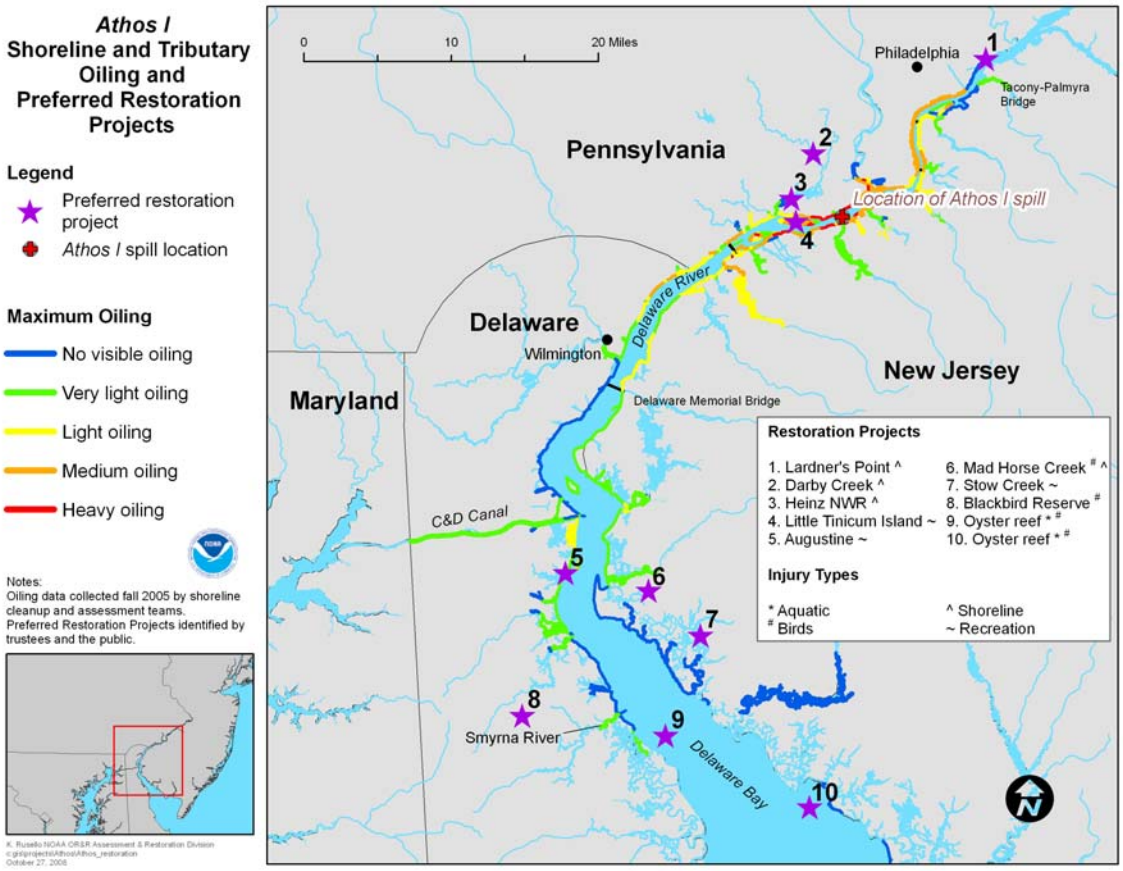


Figure 8. Approximate location of restoration projects and origin of the *Athos* oil spill.

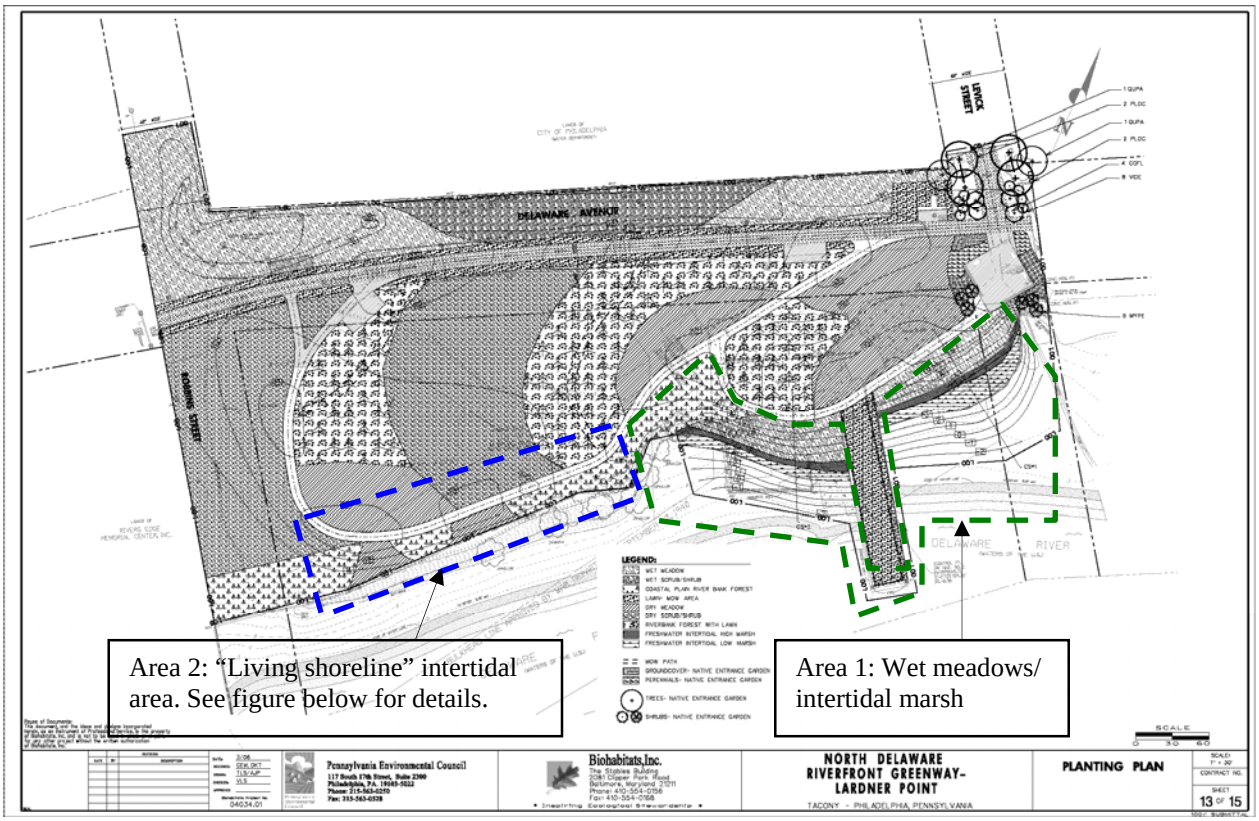
Project Description - Lardner's Point

The Lardner's Point restoration site is located in the greater Philadelphia region, at the northern end of the area oiled by the *Athos* spill. Just west of the Tacony-Palmyra Bridge, the site is situated in the Tacony neighborhood of Philadelphia, bordering the west bank of the Delaware River. Lardner's Point is the former home of a river ferry that provided service between Tacony and Palmyra, prior to the construction of the Tacony-Palmyra Bridge in 1929. Following the completion of this bridge, ferry service ceased and the land remained inactive under the ownership of the City of Philadelphia and associated entities. Today, the 4-acre lot, still under city ownership, is a barren industrial site, consisting of a deteriorating concrete pad in the north section, with a dilapidated ferry dock and boat ramp on the eastern shoreline. The remainder of the site is vegetated with invasive species.

Conceptual restoration plans for the site (Figure 9) have been developed jointly by the Delaware River City Corporation, Pennsylvania Environmental Council, and Fairmount Park Commission, and include multiple shoreline, upland, and recreational components. The project is a key access point for the North Delaware Riverfront Greenway, and would enhance riverfront access. Partners in the upland portion of the site include the Pennsylvania Department of Conservation

and Natural Resources, the Philadelphia Commerce Department, the East Coast Greenway Project, and the Delaware Valley Regional Planning Commission. The shoreline restoration component proposed to compensate for a portion of the *Athos* losses involves demolishing existing structures, removing debris, importing fill material, grading the site to restore tidal inundation, and creating and planting intertidal marsh and wet meadow habitat. A "living shorelines" approach would be used, with excavated rock forming a toe sill at the marsh edge to stabilize the area and protect it from erosion. A total of 0.9 acres of intertidal marsh and wet meadow would be restored.

The State of Pennsylvania would serve as the LIT, with Trustee Council oversight.



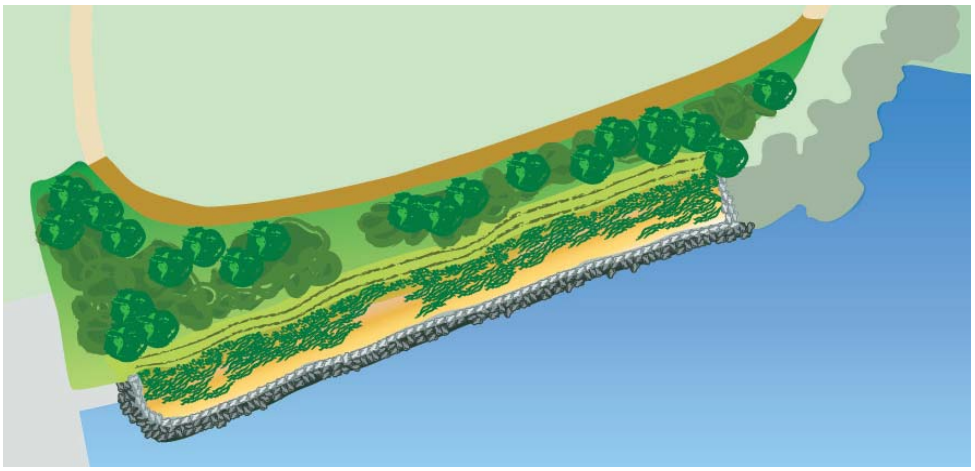


Figure 9. Lardner's Point conceptual restoration plan. Approximate areas that are part of the *Athos* restoration plan are outlined. Additional details for "living shoreline"/intertidal area shown in bottom image.

Restoration Objective

The objective of these two restoration projects is to provide 1,202 DSAYs of shoreline habitat to compensate for the lost shoreline services resulting from the spill.

Scaling Approach

The Trustees quantified a spill-related resource loss of approximately 1,335 DSAYs of shoreline habitat (Shoreline Assessment Team 2007), consisting primarily of injury to tidal flats (1,032 DSAYs) (Table 19). However, as noted above, this value is reduced by ten percent to account for baseline conditions in the mainstem of the Delaware River, resulting in an adjusted resource loss of approximately 1,202 DSAYs.

Given the lack of suitable tidal flat projects, the Trustees scaled injuries to tidal flats (and other non-marsh shoreline injuries) using marsh habitat, taking into account differences in the biogenic structure (generally represented as primary productivity) provided by the habitat.[20] The first step in scaling the injury is to therefore estimate all non-tributary shoreline injuries, in terms of marsh habitat, as marsh DSAYs. Created marsh would provide some of the same services as tidal flats, including habitat for benthic infauna and a site for primary and secondary production. Marsh would also provide many additional services, benefiting a wide-range of resources, above and beyond that provided by tidal flat habitat. Based on estimates of structural habitat provision from a range of studies on the east coast, an appropriate habitat equivalency ratio between intertidal flat and marsh is approximately 2.5:1 (Peterson et al. 2007).[21] Injuries to other mud/sand substrates (shorelines and the lower intertidal zone) are converted using the same ratio, due to similar characteristics and their relatively small contribution to shoreline injuries.

Rip-rap (the primary constituent of the "coarse substrate" injury) and seawalls are a relatively minor component of the total shoreline injury (157 DSAYs). Created marsh habitat would provide erosion protection, refuge for organisms, and a site for primary and secondary production. While rip-rap and seawalls can reasonably be expected to generate substantially less productivity per unit area than marsh, the Trustees have been unable to identify quantitative data that can be used to develop a "rip-rap and seawall to marsh" equivalency ratio. In the absence of such data, the Trustees adopt a 10:1 equivalency ratio between these habitats, based on qualitative comparisons and professional judgment applied to similar injuries in a past NRDA case (LOSCO et al. 2001).

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[20] Structured habitats (e.g., marsh, oyster reef) have significantly higher levels of productivity at multiple trophic levels than do unstructured habitats (e.g., unvegetated tidal flat) (Peterson et al. 2007). The methodology compares relative productivity of the habitats and evaluates the contribution of physical structure (e.g., plants, reefs) to productivity.

[21] The ratio of 2.5:1 is based on productivity ratios derived from the level of structural provision (Peterson et al. 2007). The habitat equivalency ratio indicates that 2.5 acres of intertidal flat provides similar service to one acre of marsh. Therefore, to calculate the intertidal injury in terms of marsh DSAYs, the intertidal injury is divided by 2.5.

Based on the above assumptions, shoreline injuries total 470.6 "marsh" DSAYs (Table 20).

Table 20. Compensatory restoration acreage by habitat type.

Habitat Classification	Acres	Adjusted DSAYs[a]	Marsh DSAYs[b]	Marsh Restoration Acres[c]
Marsh	117	54	54.0	4.0
Sand/Mud substrates	36	32	12.6	0.9
Lower Intertidal Zone	83	46	18.4	1.4
Tidal Flats	1,298	929	371.5	27.7
Coarse Substrates	137	114	11.4	0.9
Seawalls	59	27	2.7	0.2
Total	1,730	1,202	470.6	35.1

[a] Adjusted DSAYs take into account the baseline injury estimate for the Delaware River (a ten percent ecological service loss).
[b] Marsh DSAYs are calculated by dividing DSAYs by habitat equivalency factor (1 for marsh; 2.5 for sand/mud substrates, intertidal and tidal flats; and 10 for seawalls and coarse substrates).
[c] Marsh restoration acres are calculated by dividing marsh DSAYs by the weighted average per-acre credit for restored marsh (13.4 DSAYs/acre).

The HEA method was used to determine the amount of marsh restoration needed to compensate for the losses resulting from the spill (NOAA 1999). HEA considers several project-specific factors in scaling restoration, including elapsed time from the onset of injury to restoration implementation, relative productivity of restored habitats (that is, the proportional equivalence of ecological services provided by the compensatory restoration project relative to the baseline productivity of the injured habitat), the time required for restored habitats to reach maximum function, and project lifespan.

To determine the appropriate estimates for the HEA input parameters identified above, the Trustees relied on resource agency staff experience with creating wetlands in this region, data from other damage assessment cases, and information in the scientific literature. The Trustees assume that marsh construction for Lardner's Point would begin in 2009, while Mad Horse Creek would begin in 2010.[22] Ecological services are expected to develop following a logistic model, reaching maximum service in 15 years (French McCay and Rowe 2003). For Mad Horse Creek, a baseline ecological service of 10 percent is used. This reflects the minimal level of service provided by the current area of *Phragmites*-dominated, disturbed wetlands.[23] At Lardner's Point, a baseline ecological service of zero is used, reflecting the current state of the property, which is abandoned industrial upland, covered in invasive plants such as knotweed, with a steep riverbank. The maximum service level for this project is estimated to be 85 percent, reflecting Trustee experience that restored marshes generally do not reach productivity levels

[22] The projected 2010 construction date for Mad Horse Creek is due to the scale of the project.

[23] Roughly 38 acres of the current Mad Horse Creek site targeted for restoration is a degraded *Phragmites* marsh with minimal tidal connectivity. The remaining target area is even more substantially filled and does not provide significant wetland services.

associated with natural, fully functional marsh habitat. [24] The maximum service of 85 percent is based on monitoring metrics, which require 85 percent coverage of desired vegetation, as well as additional hydrologic requirements. The project life span is estimated to be 50 years.[25] Based on these inputs and using the 3 percent annual discount rate typically applied in HEA calculations, each restored acre at Mad Horse Creek provides a credit of 13.4 service acre-years and each acre at Lardner's Point provides 15.6 service acre-years (see Appendix 4 for calculations). The 0.9 acre site at Lardner's Point provides 14 DSAYs; therefore, an area of 34.2 acres at Mad Horse Creek would compensate for the remaining 456.6 marsh DSAYs estimated above (Table 20). For the overall 35 acres of restoration, the average credit is 13.4 service acre-years.

Probability of Success

Mad Horse Creek and Lardner's Point restoration projects involve feasible and proven techniques with established methodologies and documented results. Local, state, and federal agencies have successfully implemented similar wetland creation projects in this region of the Delaware River. Thus, the Trustees believe that the projects have a high likelihood of success.

The Mad Horse Creek and Lardner's Point projects are located on land already owned by the government (NJDEP and City of Philadelphia, respectively). While final details of the marsh restoration projects remain to be fully developed, the Trustees would carefully monitor plant handling and installation to ensure that appropriate guidelines are being followed. With respect to revegetation efforts, all plant material would be inspected to ensure that it is healthy and vigorous, and would be protected during mobilization from drying and physical damage. Plants intended for use in these projects would be correctly labeled with scientific name and be native to the area. Furthermore, plants would be provided by certified nurseries that have been inspected by state and/or federal agencies, and seed shall have a designated percentage of pure live seed. Container grown plants would be treated with a slow-release fertilizer at the time of planting. Replanting would occur if a significant number of plants die. For these reasons, the Trustees believe that these projects have a high likelihood of success.

These projects are consistent with existing federal, state, and local restoration goals (as found in DRBC 2005; Partnership for the Delaware Estuary 2005; Kreeger et al. 2006; and Westervelt et al. 2006) for the Delaware River. Lardner's Point is a key public access point for the North Delaware Riverfront Greenway currently being developed by the Delaware River City

[24] Maximum ecological service for restored wetlands is generally considered to be less than 100 percent, due to the difficulties in creating a complex natural system. For example, the Chalk Point NRDA estimated the maximum potential service for restored wetlands to be 80 percent (NOAA et al. 2002). The differences in natural versus created marshes are discussed in Strange et al. (2002).

[25] The project lifespan is estimated based on the historic rate of sea level rise near the proposed sites. The rate for the Delaware River at Philadelphia is 3 mm/yr based on tidal gauges. A similar rationale was used for a 50-year marsh lifespan in the marsh restoration following the Chalk Point spill (NOAA et al. 2002), where historic rates of sea level rise in the mid-Chesapeake near the Patuxent River are also 3 mm/yr.

Corporation. The Greenway projects involve broad support from various government partners (City of Philadelphia, State of Pennsylvania, National Park Service) as well as public officials and local civic associations and non-profit groups.

Performance Measures and Monitoring

Project performance at Mad Horse Creek and Lardner's Point would be assessed by comparing quantitative monitoring results to predetermined performance standards. These standards would be based partially on guidelines established by NJDEP for assessing wetland mitigation projects (Appendix 4), as well as other published scientific literature. Restored habitats at Lardner's Point would be monitored once a year, in early fall, for five full growing seasons. Restored habitats at Mad Horse Creek would be monitored once a year, in early fall, for five full growing seasons, then in years seven and ten. Monitoring once per year differs from language in the draft DARP/EA, which called for twice per year for five years. The extension of monitoring at Mad Horse through year ten would allow for more accurately gauging success of the project in meeting compensatory requirements. Monitoring assessments would include documentation of hydrologic regime, soil characteristics, plant species present, and confirmation of planned site grading and elevation. At the end of the monitoring period, a survival rate of 85 percent of planted vegetation (and/or similar native vegetation) should be documented; less than 10 percent of plant species should be characterized as non-native, invasive, or noxious. At the conclusion of monitoring, the created wetland areas should be delineated using federal standards and the final acreage corroborated with compensatory requirements.[26]

The monitoring program for these two projects would use the standards described above to determine whether the project goals and objectives have been achieved, and whether corrective actions are required to meet the goals and objectives. In the event that performance standards are not achieved, or monitoring suggests unsatisfactory progress toward meeting established performance standards, corrective actions would be implemented. Possible corrective actions include regrading the area to proper elevations and replanting appropriate vegetation. Any necessary corrective actions would be funded by the contingency component of the project costs.

Approximate Project Costs

Table 21 provides a summary of expected costs for restoring 34.2 acres of marsh habitat at Mad Horse Creek and 0.9 acres at Lardner's Point. Estimated project costs of approximately $200,000 per acre for Mad Horse Creek reflect site characteristics and Trustee experience with similar restoration projects in New Jersey. Following the design phase, a more detailed cost estimate would be available. The current estimate is based on similar projects conducted in the New Jersey/New York area, particularly the Woodbridge Creek marsh restoration project. The Woodbridge restoration consisted of 23.6 acres of wetland restored by the U.S. Army Corps of Engineers as mitigation for harbor dredging; an additional 8.7 acres at the site was restored for compensation following the 1990 Exxon Bayway spill. Overall, the project scope is similar to the

[26] Specifically, wetlands will be delineated using the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (Federal Interagency Committee for Wetland Delineation 1989).

proposed marsh restoration at Mad Horse Creek. The Woodbridge Creek site was dominated by *Phragmites*, requiring dredging and regrading to restore tidal flow and re-create the native salt marsh. The project included extensive planting of marsh plants and native vegetation. Final implementation costs at the Woodbridge Creek site are roughly $250,000 per acre, with a total project implementation cost of roughly $6.4 million.

Estimated costs for the Lardner's Point project were obtained from site-specific planning work performed by Biohabitats, Inc. Monitoring costs for both projects reflect New Jersey monitoring experience for similar restoration projects, consistent with monitoring requirements identified in the Performance Measures and Monitoring section. A 25 percent contingency (Table 47) is included to cover the risk that (1) the costs of the project turn out to be higher than expected; and/or (2) the project does not result in the expected magnitude of benefits and needs augmentation. As shown, estimated project costs total $6,808,125 for the Mad Horse Creek Project and $643,271 for the Lardner's Point project.

Table 21. Summary of Project Costs: Mad Horse Creek and Lardner's Point Restoration Projects.

Cost Element	Total
MAD HORSE[1]	
Planning and Design	$178,692.51
Construction	$6,349,486.67
Monitoring	$355,951.86
Operation and Maintenance	$131,934.05
TOTAL*	**$7,016,065.10**
LARDNER'S POINT	
Planning and Design	$111,320
Construction	$386,223
Monitoring	$103,159
Operation and Maintenance	$42,569
TOTAL*	**$643,271**

Notes:
[1] The Mad Horse project represents costs for 34.2 acres of non-tributary habitat restoration.
* Total project costs do not include contingencies of 25% which are shown in Table 47.

5.5.1.2 - Restoration of Tributary Losses: Dam Removal and Riparian/In-stream Habitat Restoration on Darby Creek and Habitat Restoration at John Heinz National Wildlife Refuge

The Trustees determined that approximately 1,899 acres of tributary habitat—shorelines, extensive wetlands, intertidal flats, and shallow benthic habitats—injured by the *Athos* oil spill

equaled a spill-related resource loss of approximately 524 DSAYs. [27] To compensate for this loss, the Trustees propose two restoration projects. The first is removal of three dams and a remnant bridge pier from Darby Creek in southeastern Pennsylvania, followed by restoration of the in-stream and riparian areas. In addition to habitat improvement, this project would open approximately 2.6 miles of the creek to anadromous fish. The second project would be undertaken at John Heinz National Wildlife Refuge (NWR), located near the mouth of Darby Creek, and would create a series of tidally connected channels, shallow pools, and fringing wetlands functionally similar to tributary habitat in a currently unproductive portion of the Refuge dominated by heavy stands of the invasive species *Phragmites australis*.

Project Description: Darby Creek

Darby Creek, in southeastern Pennsylvania, (Figure 10) currently has three low dams and a remnant bridge pier that interfere with stream flow and the movement of anadromous fish (Sara Strassman, American Rivers, personal communication) (Table 22). The first proposed project would remove the four obstructions and implement in-stream and riparian restoration for up to 1,000 feet upstream and downstream of the current obstructions.

Table 22. Description and location of Darby Creek obstructions.

Obstruction	Location (River Mile)	Owner	Height (feet)
Colwyn bridge pier	7.31		n/a
Dam 1: Darby Borough	7.91	Borough of Darby	6
Dam 2: Hoffman Park	9.63	SEPTA[a]	4
Dam 3: Kent Park	10.1	Delaware County	6
End of Reopened Stream Reaches	10.51		

[a] Ownership of the Hoffman Park dam is historically uncertain, but the Pennsylvania Department of Environmental Protection (PADEP) is satisfied that Lansdowne Borough will take responsibility.

Downstream of the first dam, a variety of anadromous fish are found, including alewife, striped bass, and shad (NOAA 2003). Dam removal is expected to restore normal stream channel flows and facilitate passage of anadromous fish into the upper watershed. Riparian restoration and enhancement following dam removal would improve the general health of the creek and provide highly functional tributary habitat.

The first obstruction is the Colwyn bridge pier. The remnant bridge pier is the remainder of an abandoned railroad bridge. The steel and concrete pier interferes with sediment transport and creates debris jams, which caused localized flooding, leading to damages to riparian and in-stream habitat. Surrounding the pier footings are accumulated debris and an impounded area, covering roughly 0.2 acres. The restoration consists of removing the center and right bank piers to below grade, excavating the impounded sediments and debris, and regrading the streambed. Due to the very steep embankments in the area, limited riparian restoration is planned. At the

[27] Tributary habitats do not have a comparable baseline injury to the mainstem shorelines. Therefore, no baseline adjustment is made to the tributary injury assessment values.

Colwyn Pier location, the majority of sediment upstream of the structures was predominantly a sand bar behind the central pier. The maximum depth recorded by the land surveyor was 1.7 feet; however, the maximum sediment depth on the downstream reach was 1.6 feet. Once the pier is removed, this sand bar should be redistributed with little to no impact to downstream natural resources. It is estimated that the delta upstream of the piers contains 770 cubic yards of coarse grained sediment. Based on our field observations and sediment analysis, the sediment delta that formed upstream of this structure will redistribute over time and not put an undo loading on downstream resources.

The Darby Borough dam is currently partially breached, as one half of the dam has been largely washed away. The habitat has been degraded due to sediment trapping and undercutting of the banks, with an artificially straightened channel. The design plans call for creation of additional stream length in the portions of the straightened channel, as well as the creation of bed topography and habitat that would be sustained by the restoration of dynamic flows. Extensive grading and reconstruction of the streambed and floodplain are planned. The riparian landscape plan includes a combination of wetland seeding, lowland and upland shrubs, and meadow seeding. To the extent possible, existing trees would be incorporated into the design, and additional trees are planned, such as maples, river birch, and viburnum. The sediment volume is estimated to be 600 cubic yards and will require removal to access the concrete structures for demolition. This material could be disposed just outside of the streambed, within Bartram Memorial Park. The remaining sediment upstream of the dam structure would not require mitigation or management due to it similar grain size distribution to the upstream and downstream reference reaches. Therefore, it is expected that this material will redistribute over time, without negative impacts to downstream resources.

Following removal of the Hoffman Park dam, the impounded sediments would be removed from the streambed and the site restructured. A small portion of the dam would remain on one side to allow fishing access. Removal of a portion of the structure will require the excavation of sediment immediately behind the dam. Due to the granular nature of the impounded sediment, it is expected that only the removal of sediment that impedes the demolition of the dam (180 cubic yards) will be required. This sediment would likely be disposed of within the adjacent Hoffman Park fields. The remaining impounded sediment which consists of a grain size distribution and low organic content similar to the overall stream could remain in place and allow for riverine processes to redistribute the materials. One bank would be contoured with a boulder toe and coir blocks with rooted live cuttings, covering more than 500 linear feet.

Following dam removal at the Kent Park dam, the channel would be regraded and lined with river stone. The current open grass area adjacent to the creek would be graded and vegetated with a combination of wetland seeding, lowland and upland shrubs, and meadow seeding. Due to the highly organic nature of the material and its relatively fine grain size distribution, when compared to the reference reach samples, the impounded material would be dredged prior to complete dam removal. It has been quantified that this reach contains up to 3,000 cubic yards of sediment behind the structure, extending to the North Marple Street bridge. However, due to the existence of an open field adjacent to the impoundment, the sediment could be simply placed within this open area. Based on measurements obtained during the survey, this sediment could be distributed within the field at a wet depth of 1.2 feet. It is anticipated that due to the organic

nature of the material and its high moisture content (77%), the final height of material after dewatering would reduce less than 12 inches.

The state of Pennsylvania would serve as the LIT, with Trustee Council oversight, for the Darby Creek project.

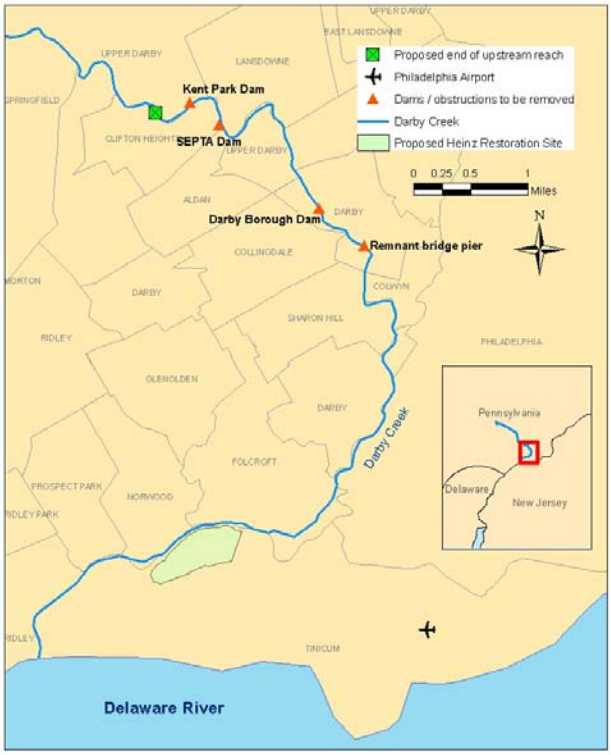

Figure 10. Location of Preferred Restoration Projects for Tributary Injuries.

Project Description: John Heinz National Wildlife Refuge (NWR)

The Henderson Dike Area (Figure 11) at John Heinz NWR, also known as FL-4 in the Refuge's restoration plan, was historically a freshwater tidal wetland, but was used as a dredge material disposal site by the U.S. Army Corps of Engineers (USACE) until the mid-1960s. Recent mitigation projects (the Blue Route Mitigation Site (1992) and the Philadelphia International Airport Mitigation Site (1996)) have begun to return the area to its tidal wetland status. Both of these projects involved the removal of organic fill and the restoration of tidal exchange. The remaining unrestored area on-site comprises 56 acres and contains approximately 2 to 4 feet of fill. This area is currently minimally affected by tidal influence and is dominated by an invasive plant species, *Phragmites*, which severely limits its habitat value for wildlife. To restore this area, former restoration plans called for the removal of several feet of fill and restoration of tidal exchange. This plan was considered; however, the excessive costs and placement of the spoils presented difficulties.

On further consideration, a proposal to excavate a series of channels and pools and place the material adjacent to the pools to form saturated scrub/shrub wetlands was developed. The 7 acres of channels and pools would restore tidal flow to the area and allow wild rice seed and other native plants to be transported into the wetland interior with the tide. Indirect benefits to the remainder of the 56-acre parcel would result from occasional flooding/flushing during storm surges and/or other high tide events, leading to modest ecological improvements throughout the entire site. The channels would also provide habitat for numerous anadromous fish species. A detailed alternatives analysis will be conducted to determine the most cost-effective design to increase tidal exchange to the site including various channel alignments, breaching of the dike, and alternative disposal options. While flooding as a result of increased tidal exchange would potentially lead to decreased stands of *Phragmites,* the affected areas would require periodic treatment into the future. The proposed scrub/shrub wetland areas would also enhance the habitat functions of the marsh by creating potential nesting sites for reptiles and waterfowl, and roosting sites for wading birds.

The U.S. Fish and Wildlife Service would serve as the LIT, with Trustee Council oversight, for the John Heinz NWR project.

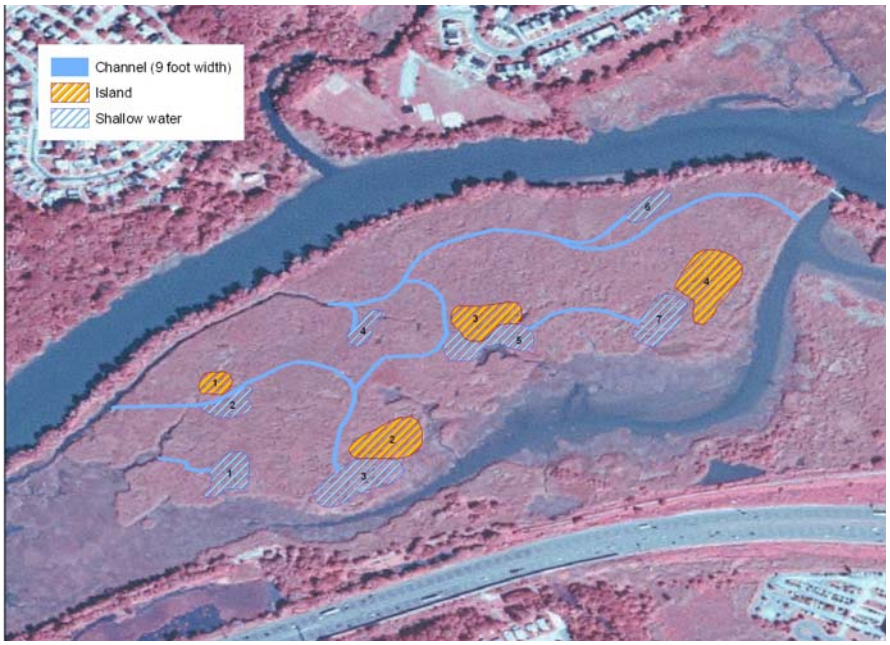

Figure 11. Conceptual plan for the John Heinz NWR Restoration Project. Blue lines represent proposed channels. Yellow and blue shaded areas are proposed shallow ponds.

Restoration Objectives

The objective of the two restoration projects is to provide 524 DSAYs of ecological benefit to tributary resources. Dam removal would allow use by anadromous fish, similar to those found in unobstructed reaches injured by the *Athos* oil spill, and would improve the in-stream conditions for other fish. Restoration of normal stream channels through removal of the dams and remnant

bridge pier also would enhance sediment transport and reduce sediment deposition, providing ecosystem enhancement. Riparian and in-stream habitat projects would improve habitat for diamondback terrapins, wading birds and shorebirds, and other fauna that make use of shoreline habitat (Shoreline Assessment Team 2007). Marsh restoration at John Heinz NWR would restore habitat similar to the tributary wetlands and intertidal habitat injured in the spill.

Scaling Approach

The Trustees calculated a spill-related tributary resource loss of approximately 524 DSAYs (Shoreline Assessment Team 2007). The injury to tributaries is scaled to a stream restoration project in Darby Creek and to a habitat restoration at John Heinz NWR. As described in more detail below, the Darby Creek restoration project is quantified as generating approximately 234 DSAYs of tributary ecological benefit, and the NWR restoration project is expected to generate approximately 222 DSAYs of tributary ecological benefit, for a quantified total of approximately 457 DSAYs. Although less than the quantified tributary resource loss (524 DSAYs), the Darby Creek project provides additional benefits to anadromous fish that are not quantifiable on the acre scale on which the injury was calculated. Given the desirability of these outcomes, the Trustees believe that the preferred restoration projects are appropriately sized to offset *Athos*-related tributary injuries.

Darby Creek Dam Removal

The first proposed restoration project—Darby Creek dam removal and riparian/in-stream restoration—would result in increases in diadromous fish, particularly the American shad, as well as likely improvements in vegetation and macroinvertebrates and a decrease in localized flooding near dams during high water events. While not completely prohibiting the movement of migratory fish, the remnant bridge pier and the Darby Borough dam interfere with stream flow and streambed structure and cause flooding events (D. Kristine, personal communication); their removal is essential to realize the in-stream ecological improvements from dam removal. General habitat improvements from the removal of the four obstructions would include an increase in occasionally inundated riparian areas (i.e., an increase in fringing wetland) in upstream areas (Shafroth et al. 2002). Species shifts in macroinvertebrates and fish species from slow to fast moving water are also generally observed in the former impoundments upstream of small dams (Hart et al. 2002).

Recent research on the effects of small dam removal has resulted in several models of ecosystem improvements. Doyle et al. (2005) synthesized several small dam removal studies in Wisconsin to examine how the physical effects of dam removal (e.g., changes in channel form, habitat type) affected riparian vegetation, fish, macroinvertebrates, and nutrient dynamics.[28] Different

[28] While the dams studied in the paper are located in Wisconsin, the Trustees expect similar responses in Pennsylvania due to similarities in dam type and age and stream width. Those reviewed in Doyle et al. (2005) are also century-old dams on small channels with declining structural integrity. Impoundments are reasonably small but have silted in considerably over the past hundred years. Widths were similar, with 30-130 ft for Darby Creek and 40-90 ft in Wisconsin. The most significant difference in the potential dam removal projects is the

components of the ecosystem recovered at different rates. Riparian vegetation appeared to require the greatest time to reach a new equilibrium, while macroinvertebrates required the shortest time.

To evaluate the effect of dam removal on fish communities, Doyle et al. (2005) used habitat index values to estimate the relative value of habitat following dam removal. The index uses quantitative habitat characteristics such as riffle occurrence, cover for fish, and substrate type to value habitat on a 100-point scale in regions upstream and downstream of a small dam removal (Kanehl et al. 1997). In areas upstream of the dam removal, particularly in the impounded area, the study authors observed a significant improvement over a 5-year period in habitat value (increase of 40 percentage points in the first mile, 55 percentage points in the next half mile, and 10 percentage points for the following half mile, Table 23).[29] The first two reaches are representative of impounded areas, while the third reach upstream represents habitat upstream of the impoundment. While only a small reach downstream of the dam was evaluated (0.8 miles), an increase of 15 percentage points occurred in that area (Doyle et al. 2005).

Table 23. Increase in habitat index values 5 years after dam removal.

	0-0.8 miles downstream	0-1 mile upstream	1-1.5 miles upstream	1.5-2.1 miles upstream
Habitat Index Increase over Five Years	15	40	55	10

Habitat Index values are based on a 100-point scale. Source: Doyle et al. 2005

For scaling purposes, the Trustees applied similar habitat index improvements to those found in Doyle et al. (2005) following dam removal (Table 23) to the Darby Creek restoration project.

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prevalence of mussels in the Wisconsin waterways, which can be detrimentally affected by dam removal, and the potential for diadromous fish passage following dam removal, which is not relevant in the Wisconsin creeks. Mussels are not prevalent in Darby Creek. Similar dam removal projects have been undertaken by the Pennsylvania Fish and Boat Commission (PFBC) and other federal, state, and non-profit organizations in Pennsylvania (e.g., Wyomissing Creek, Schuylkill River, Conestoga River). These projects demonstrate significant improvements to biotic communities and stream flow, although not providing a quantitative estimate of ecological improvement. Return of anadromous fish (Conestoga, Schuylkill), improvements in growth and survival of wild or stocked fish (Wyomissing, Conestoga), and increases in macroinvertebrate diversity and abundance (Conestoga) have all been noted (PFBC 2007).

[29] The current impoundments on Darby Creek may not extend to 1.5 miles upstream of the obstructions; however, benefits in the third category (1.5 to 2.1 miles upstream) are representative of improvements to the habitat index above the impoundments. Additionally, substantial benefits were recorded for fish (a greater than 10 times increase in biomass for the indicator species, smallmouth bass) in the area above the impoundment (Kanehl et al. 1997). Therefore, we maintain the same distances and improvements used in Doyle et al. (2005).

Based on the size of observed impoundments upstream of the obstructions, the Trustees do not expect to see improvements for the length upstream indicated by Doyle et al. (2005). Therefore, they rely on the physical characteristics of the creek and recommendations of local experts (e.g., PFBC and American Rivers) to identify the likely areas of major instream improvement. These areas of "major" improvement are considered comparable to the first two upstream zones described by Doyle et al. (2005). Therefore, a habitat improvement of 50 percent is assigned to the "major" improvement areas. Adjacent creek areas are expected to have smaller but measurable benefits; given the difficulty in determining this area, an estimated area of half the "major" improvement zone is used. A habitat improvement of 15 percent, comparable to the 1.5 to 2.1 miles upstream zone, is used for the minor improvement areas.

The HEA method was used to determine the scope of restoration necessary to compensate for the losses resulting from the spill (NOAA 1999). To determine the appropriate estimates for the HEA input parameters identified above, the Trustees relied on resource agency staff experience with creating wetlands in this region, data from other dam removals in Pennsylvania, and information in the scientific literature. The Trustees assumed that the dam removal would take place in 2009. Linear improvements to the levels described above and shown in Tables 24 and 25 were assumed to occur over a 5-year period following project implementation.[30] Benefits were assumed to accrue in perpetuity, given that most of the restoration would occur in areas adjacent to or on parklands and in areas unlikely to be affected by sea level rise. Based on these inputs and using the 3 percent annual discount rate typically applied in HEA calculations, an acre of streambed with 5 percent uplift would provide a credit of 1.48 DSAYs.[31] Values for each restoration area, reflecting length, width, and ecological uplift, are shown in Table 24 (see Appendix 4 for detailed calculations). Overall, removal of the bridge pier and the three dams and associated in-stream restoration projects are expected to provide a credit of 108 DSAYs.

[30] Based on Doyle et al. (2005), the Trustees presume that most habitat improvements occur within 1 to 5 years.

[31] Five percent is used as a basis for calculations. Therefore, a 1-acre area with 10 percent uplift would provide 2.96 DSAYs (2 * 1.48).

Table 24. Characteristics and ecological benefits of obstruction removal and in-stream improvements for each site on Darby Creek.

	Anticipated Area of In-stream Improvements			Primary Benefit[d]	Secondary Benefit
Obstruction	*Width (ft)*[a]	*Length (ft)*[b]	*Acres*[c]	*DSAYs*	*DSAYs*
Colwyn Bridge Pier	72	960	1.59	23.5	3.5
Darby Borough Dam	66	1280	1.94	28.7	4.3
Hoffman Park Dam	56	680	0.87	12.9	1.9
Kent Park Dam	80	1067	1.96	29.0	4.3
Total			**6.36**	**94.1**	**14.1**

[a] Width is calculated from the "top of bank" line and/or "ordinary high water line" on engineering schematics provided by American Rivers.
[b] Length of major improvement area is estimated from stream structure and professional judgment (American Rivers).
[c] In-stream acreage is calculated as segment length (in feet) multiplied by average segment width (feet), divided by 43,560 square feet per acre.
[d] Primary benefit occurs in the "major improvement area" and is estimated at 50 percent improvement. Secondary benefit occurs in an area half the size of the major improvement area and is estimated at 15 percent improvement. Parameters for DSAY calculations are provided in Appendix 4.

Improvements to the riparian buffer zone would provide additional ecological benefits. As described above, a portion of the *Athos* spill-related injuries occurred in shoreline and wetlands areas along the six affected tributaries. The current riparian zone is minimally functional in many areas of Darby Creek, particularly where obstructions in the river have washed out adjacent banks and loaded debris onto floodplains. Several areas are covered in invasive plants such as Japanese knotweed. Dam removal would naturally enhance these areas due to creation of wetlands and reductions in extreme flooding events (Shafroth et al. 2002). Additionally, direct riparian restoration would take place in the vicinity of the dams after removal. Based on current landscape plans for the project, the expected direct restoration/enhancement area is approximately 4.5 acres (Table 25). Anticipated work includes stream bank stabilization, grading, riparian vegetation, and in-stream vegetation. (Additional information for each obstruction is provided in the project description.) The projects would be converting minimally functional riparian habitat into fully-functioning riparian buffer zones.

For restoration scaling purposes, uplift assumptions applied to the wetlands revegetation projects are applied to the riparian improvements. Similar to *Phragmites*-dominated, degraded wetlands, a baseline ecological value of 10 percent is applied, reflective of the invasive species and minimal connectivity. A maximum ecological service of 85 percent is used, comparable to values used for Mad Horse Creek and Lardner's Point, for a net improvement of 75 percent. Similar to the in-stream restoration, a smaller improvement in areas adjacent to the direct major improvements is assumed, due to the improved seed bank and the reduced bank erosion and siltation as a result of in-stream improvements. The Trustees assume an area half the size of the direct revegetation area, and with half the overall improvement (i.e., a net improvement of 37.5

percent). Overall, the dam removal project would create 4.5 acres of direct buffer habitat restoration (primary benefit), with an additional 2.3 acres of indirect improvement (secondary benefit), which would provide 126 DSAYS (Table 25). The combination of riparian restoration (126 DSAYs) with the calculated benefits for dam removal on Darby Creek (108 DSAYs, Table 24) would provide approximately 234 DSAYs of quantified ecological benefit. As noted previously, additional benefits are expected to accrue from the restoration of diadromous fish; however, these benefits are not quantifiable on the DSAY scale used to calculate injury.

Table 25. Ecological uplift approximations for riparian buffer enhancement.

	Riparian Improvement[a]	**Primary Benefit**	**Secondary Benefit**
	Acres	*DSAYs*	*DSAYs*
Colwyn Bridge Pier	none	0.0	0.0
Darby Borough Dam	2.66	59.1	14.8
Hoffman Park Dam	0.19	4.3	1.1
Kent Park Dam	1.69	37.5	9.4
Total	**4.54**	**100.8**	**25.2**

[a] Riparian improvement areas are calculated from landscaping plans provided by American Rivers. Primary benefit applies to entire area; secondary benefit applies to an additional 50 percent.
[b] DSAY calculations are described in Appendix 4.

John Heinz NWR Habitat Restoration

The scaling approach for the NWR habitat restoration includes two components: 1) the calculation of ecological benefits (measured in DSAYs) directly resulting from the creation of tidally connected channel and pool habitat; and 2) the calculation of (relatively modest) indirect benefits to the remainder of the site resulting from occasional flooding/flushing during storm surges and/or other high tidal events. These calculations are summarized below.

Final project design would reflect the results of a detailed alternatives analysis and final design plan to be undertaken in the future. However, a planning-level design (Figure 11) has been developed by the Trustees based on site visits, site-specific technical data, and consideration of various restoration design alternatives. This design would result in the creation of approximately 4.5 acres of shallow pools, 1.2 acres of channels, and 1.3 acres of channel buffer habitat.[32] For scaling purposes, this would result in restoration of approximately 7.0 acres of restored habitat that is expected to be functionally similar to tributary habitat. This approach is consistent with Trustee tributary injury calculations, which combined tributary subtidal, intertidal, and a small width of adjacent shoreline acreage into a total acreage of injured "tributary habitat."

[32] For scaling purposes, ecological benefits of channel creation are assumed to extend 5 feet to either side of the excavated channel. This approach is consistent with tributary injury calculations, which included 5 feet of shoreline on both sides of injured tributaries.

Scaling calculations for the 7.0 acres that would directly benefit from restoration activities assume an ecological uplift of 70 percent. This assumption reflects the fact that much of the site is currently covered by a mat (several inches to greater than 12 inches) of *Phragmites*, which exports minimal productivity to the tributary system. The site has been in this condition for several years; recovery of the native vegetation has been very slow due to the presence of the *Phragmites* and a lack of tidal flushing. This mat would be removed in excavated channel and pool areas, and elevations lowered sufficiently to turn these 7.0 acres into what the Trustees expect would be fully functioning, tributary-like habitat. A rapid improvement in ecological services is expected for the Heinz project following the physical creation of channels and ponds. Similar to improvements following dam removal, the Trustees expect to see rapid improvement in the first few years following project implementation. For benefit calculations, a linear improvement in the first 3 years is used. Baseline ecological services for the site as tributary habitat are estimated at 10 percent. Following restoration, the Trustees estimate maximum ecological services of 80 percent. Restoration is assumed to begin in 2010, and provide a 23 percent uplift in 2010, 47 percent uplift in 2011, and 70 percent uplift in 2012 (and future years). Restoration benefits are summed through 2059, reflecting the expectation that ecological benefits are likely to be sustained for several decades. Consistent with standard practice in scaling calculations, future benefits are discounted at an annual rate of 3 percent. Based on these parameters, the "direct" benefits of creating approximately 7.0 acres of channel and shallow pool habitat total approximately 114 DSAYs (see Appendix 4 for detailed calculations).

Scaling calculations also include "indirect" benefits expected to accrue to the remaining 49 acres at the site. Creation of tidally connected channels and shallow pools throughout the site would occasionally expose this larger area to tidal inundation during storm surges and/or other high tide events. The areas surrounding the channels and ponds would experience increased flooding and seed distribution, resulting in general improvements to the tributary services provided by the area. Areas closest to the channels may experience significant improvements, possibly doubling in service levels, but improvements would lessen with distance from the channelizations. Due to the uncertain nature of the coverage of the improvements, a general uplift of 10 percent is used for the entire parcel surrounding the new channels and ponds. More specifically, scaling calculations assume 3-percent uplift in 2010, 7 percent uplift in 2011 and 10 percent uplift in 2012 (and future years). Benefits are summed through 2059 and discounted at an annual rate of 3 percent, consistent with scaling calculations for the 7.0 site acres proposed for excavation. Based on these parameters, the "indirect" benefits of the proposed project to the remaining 49 site acres total approximately 114 DSAYs (see Appendix 4 for detailed calculations).

Probability of Success

Dam removals are frequently undertaken in Pennsylvania. Since 2000, the Pennsylvania Fish and Boat Commission (PFBC), Pennsylvania Department of Environmental Protection (PADEP), American Rivers, USFWS, NOAA, and other partners have implemented the removal of 15 dams and currently have over 35 active dam removal projects in the Delaware Basin. All three dams proposed for this project are currently owned by public entities (Borough of Darby, Southeastern Pennsylvania Transportation Authority (SEPTA), or Delaware County). PFBC has maintained an extensive hatchery program for American shad over the last 20 years and now includes hickory shad as well, and has stocked millions of fry in the Delaware River/Estuary

watershed. Given the extensive experience that PFBC, American Rivers, and other agencies have in the area with dam removal and fish re-introduction, the Trustees believe that this project has a high likelihood of success.

The John Heinz NWR habitat restoration project is located within a previously established national wildlife refuge. Similar projects have already been undertaken within the refuge and have met with success. The restoration approach (i.e., excavation of channels and pools) is straightforward and highly likely to be implemented successfully and substantially improve ecological conditions at the site through removal of thick mats of dead *Phragmites* and improvements in tidal connectivity at the site.

Performance Measures and Monitoring

For the dam removal project, project performance would be assessed based on changes in physical habitat, presence and absence of fish species and numbers, and macroinvertebrate populations. Monitoring for these parameters would be conducted before removal and at 1-year intervals for the first 5 years following completion of the project. The protocols for monitoring would be tailored to be site-specific and a detailed monitoring plan will be developed prior to the removal of the dams. Completion of this monitoring program would indicate whether the project goals and objectives have been achieved, and whether corrective actions are required to meet the goals and objectives.

In the event that performance standards are not achieved, or monitoring suggests unsatisfactory progress toward meeting established performance standards, corrective actions would be implemented. Possible corrective actions include (but are not limited to) regrading riparian fringes and replanting appropriate vegetation. These corrective actions would be funded by the contingency component of the project costs (Table 47).

For the habitat restoration at John Heinz NWR, project performance would be assessed through both construction performance and vegetation performance. Channel/pond area, flow, and depth would be measured to ensure that they are sufficient for tidal exchange. Buffer plantings would be monitored to ensure biodiversity and plant survival. Restored habitats would be monitored once a year at the end of the growing period for five full growing seasons. Monitoring assessments would include documentation of hydrologic regime, soil characteristics, plant species present, and confirmation of planned site grading and elevation. At the end of the monitoring period, a survival rate of 85 percent of planted vegetation (and/or similar native vegetation) should be documented; less than 25 percent of plant species should be characterized as non-native, invasive, or noxious. If the area contains greater than 25 percent non-native, invasive, or noxious plant species, the area would be treated and a second monitoring period conducted to determine the effectiveness of the action. Any corrective actions would be funded by the contingency component of the project costs (Table 47).

Approximate Project Costs

Table 26 provides a summary of expected costs for removing three dams and one remnant bridge pier from Darby Creek and restoring 4.5 acres of riparian habitat to compensate for injuries to

tributaries. The Trustees have determined dam removal and riparian restoration cost estimates based in part on preliminary plans developed by American Rivers. Monitoring costs include PFBC staff time, equipment use, and subcontractor identification of macroinvertebrate species. Contingency values of 25 percent are shown in Table 47.

Table 26. Summary of Project Costs: Darby Creek Restoration Project.

Cost Element	Total
Planning and Design	$101,793
Construction	$1,022,485
Monitoring	$203,917
TOTAL*	**$1,328,194**

Notes:
* Total project costs do not include contingencies of 25% which are shown in Table 47.

Table 27 presents estimated project costs for the improvement of 56 acres at John Heinz NWR. USFWS has prepared a detailed cost estimate for the project based on considerable past experience in wetlands restoration on NWRs. In the event that the alternatives analysis or permitting process indicates that on-site disposal is not allowable based on contamination, hydrology, or other concerns, a disposal contingency is included. A project contingency of 25 percent is included in Table 47.

Table 27. Summary of Project Costs: John Heinz National Widlife Refuge Restoration Project.

Cost Element	Total
Planning and Design	$441,967
Construction	$2,091,690
Monitoring	$397,620
Operation & Maintenance	$37,240
TOTAL*	**$2,968,517**

Notes:
*Total project costs do not include contingencies of 25% which are shown in Table 47.

5.5.2 - Projects to Address Aquatic Resource Injuries: Creating an Oyster Reef

The Trustees quantified injuries to the 412 acres of aquatic habitat exposed to *Athos* oil as a spill-related aquatic resource loss of 97 DSAYs (see Section 4.3.3). As described below, this quantification corresponds to a loss of 4,637 kg of benthic biota.

Project Description

The preferred compensatory restoration project for restoring 4,637 kg of benthic biota would create 4.5 acres of oyster reef in the Delaware River. Both NJDEP and DNREC have established programs that create and enhance oyster beds either by direct placement of shell for natural spat settlement or a two-step process whereby shell is placed in high spat recruitment areas and then moved to areas that exhibit higher spat growth and survival. As described below, this project includes both methods to reduce the risk of project failure.

The direct placement method is proposed at the "Over the Bar" oyster beds on the Delaware side of the river (Figure 12). Shell would be placed in this historic seed bed, which currently has limited shell bottom and, as a result, low natural spat settlement rates and few adult oysters. Placement of shell during the spring and early summer would enhance the area, allowing settlement of oyster spat and recruitment of other reef-associated epifauna. Consistent with established methods employed by DNREC, the site would be seeded at a rate of 2,000 bushels/acre.

The two-step process is proposed in New Jersey portions of the River. Consistent with established oyster enhancement techniques in New Jersey, about 1,500 bushels of shell per acre would be placed in historic oyster bed areas with high spat recruitment/settlement rates (Figure 12). Three to six months following initial shell placement, spatted cultch would be harvested and transported upstream to *Athos* spill-exposed areas (e.g., the "Middle Seed" bed) (Figure 12) with lower natural mortality rates (particularly lower disease rates due to lower salinity). Shell density for replanting would be 1,000 bushels/acre. Due to constraints on available sites in the high spat area, this project would be implemented in roughly equal parts over three years, from 2009-2011. This would also decrease the likelihood of substantial project losses due to a "low" recruitment year.

Scaling calculations for both project types assume project implementation prior to mid-July of 2009 to 2011, oyster survival on the transplanted reef would be 5 years, and no harvesting of the oysters would be allowed during the initial 5-year period.

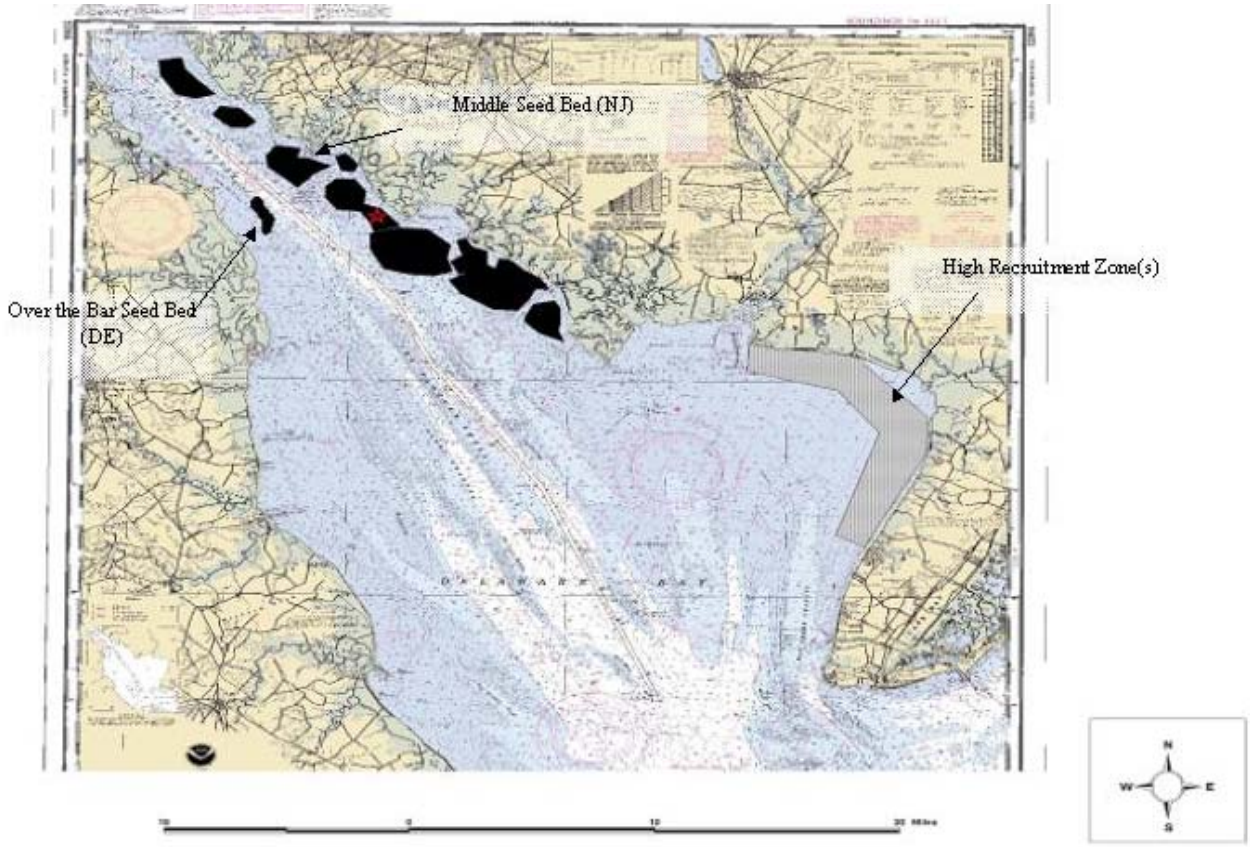

Figure 12. Locations of preferred oyster reef creation projects in Delaware and New Jersey, including location of the initial recruitment area and replanting area (Middle Seed beds) in New Jersey.

The states of Delaware and New Jersey would be the LITs for reef creation, respectively, with Trustee Council oversight.

Restoration Objectives

The objective of this project is to restore 4,637 kg of lost benthic biomass through the enhancement of equivalent benthic biomass associated with a created oyster reef. Placing shell and seeding oyster beds would directly enhance benthic habitat, with increased biomass generated by the seeded oysters and associated reef biota.

Scaling Approach

The Trustees quantified a spill-related aquatic resource loss of 97 DSAYs of benthic habitat (Aquatic TWG 2007). This estimate of lost area was converted to units of benthic macrofaunal biomass using an average benthic biomass density of 10.5 grams wet weight (ww) per m^2 (ECS

1993).[33] The ECS (1993) data were then converted to ash free dry weight (afdw), and multiplied by a productivity factor, which accounts for predation and the fact that many benthic biota are short-lived and replace their populations multiple times within each year (Howe and Leatham 1984). The resulting annual benthic productivity estimate is 47.8 kg (afdw) per acre per year. Therefore, a subtidal injury of 97 DSAYs translates to a benthic biomass loss of 4,637 kg (Table 28).

[33] ECS (1993) describes a 1-year comprehensive survey of the benthic macroinvertebrate communities of the Delaware River between the C&D Canal and Trenton, New Jersey. The survey evaluated the extent of recovery in benthic communities as a result of improved water quality following implementation of the Clean Water Act of 1972.

Table 28. Conversion of subtidal injury from DSAYs to biomass.

Step	Description	Value	Source
1	Estimated Delaware River benthic biomass (g ww) per unit area (m^2)[a]	10.5 grams per m^2 ww	ECS 1993
2	ww to afdw conversion factor[b]	15%	Nichols 1975 Soltwedel 2000
3	Estimated Delaware River benthic biomass (g afdw) per m^2)[c]	1.6 grams per m^2 afdw	Calculated
4	Productivity to biomass ratio[d]	7.5	Howe and Leatham 1984
5	Estimated Delaware River benthic biomass (g afdw) per unit area (m^2) per year[e]	11.8 grams per m^2 afdw per year	Calculated
6	Square meters to acres conversion	4,046.86 m^2 per acre	Unit Conversion
7	Estimated Delaware River benthic biomass (g afdw) per acre per year[f]	47,804 grams per acre (afdw) per year	Calculated
8	Estimated Delaware River benthic biomass (kg afdw) per acre per year	47.8 kilograms per acre (afdw) per year	Unit Conversion
9	Estimated Delaware River benthic biomass (kg afdw) per acre per year for 97 acres[g]	4,636.9 kilograms (afdw) for 97 DSAYs	Calculated

[a] Value averages: a) the benthic biomass density estimate for the "Schuylkill River to Del./Pa. border" area (reported as a combined value for intertidal, shallow subtidal, and channel); and b) the shallow subtidal category (reported as average value for Delaware River from Trenton to C&D canal).
[b] Conversion values from literature most commonly ranged between 12 to 17 percent.
[c] 1.6 g (afdw) per m^2 = 15% * 10.5 g (ww) per m^2
[d] Value is for Delaware Bay. This ratio accounts for the fact that observed biomass densities (e.g., grams per square meter) do not capture the productivity of an area over time (e.g., grams per m^2 per year).
[e] 11.8 g (afdw) per m^2 per yr = 7.5 * 1.6 g (afdw) per m^2
[f] 47,804 g (afdw) per acre per yr = 4,046.9 * 11.8 g (afdw) per m^2 per yr
[g] 4,636.9 kg (afdw) = 47.8 kg per acre yr * 97 acre yrs

To estimate the amount of additional benthic biomass from the oyster reef, the Trustees rely on the model developed for an oyster reef restoration project in the Patuxent River, Maryland (French McCay et al. 2002, Appendix 4), augmented by site-specific data from the New Jersey and Delaware oyster restoration programs.[34] Parameters for mortality rates, average shell length

[34] The salinity range for the Patuxent River site (mesohaline, between 5-18 ppt) is similar to that of the likely nursery areas in the Delaware River (the “Middle Seed” bed in New Jersey and

by age class, and shell length to tissue weight ratio are based on values for the target beds or similar locations in the Delaware River (Powell 2005; Powell et al. 2007; DDFW 2007). The size and mortality parameters used for the Delaware River are presented in Table 29. The expected lifetime of the oyster reef in a low-salinity area is approximately 5 years, due in substantial part to substrate loss and lack of recruitment. Therefore, productivity calculations are summed over a 5-year period; oysters remaining through year 5 are assumed to be contributed to the ecosystem over the following year.

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the “Over the Bar” bed in Delaware), indicating likely similarities in oyster growth and predation rates and in associated reef species.

Table 29. Created oyster reef: Oyster mortality and size parameters by age class.

Age Class[a]	Mortality[b]	Average shell length (mm)[c]	Average tissue weight (g dry)[d]	Average tissue weight (g afdw)[e]	Mid-year average tissue weight (g afdw)[f]
New Jersey – Middle Seed Bed					
0 (spat)	50%	20	0.45	0.36	0.38
1	12%	45	0.51	0.41	0.44
2	12%	51.6	0.58	0.47	0.50
3	12%	58.2	0.66	0.53	0.56
4	12%	64.8	0.73	0.59	0.62
5	100%	71.4	0.81	0.65	0.68
Delaware – Over the Bar Bed					
0 (spat)	50%	20	0.45	0.36	0.38
1	19%	45	0.51	0.41	0.44
2	19%	51.6	0.58	0.47	0.50
3	19%	58.2	0.66	0.53	0.56
4	19%	64.8	0.73	0.59	0.62
5	100%	71.4	0.81	0.65	0.68

[a] Age class refers to the "birthday" of the organisms. Age class 0 (from transplant in 2009 to first birthday) are spat. Age class 1 (from first birthday until second) are juveniles. Age class 2 and above are adults.

[b] For initial year, mortality is based on average first-year values for N.J. beds (Powell, 2005). After the initial year, mortality is based on the 2004-2006 average mortality for the Middle Seed Bed (Powell et al. 2007, Table 4) and the 2004-2006 average mortality for Delaware oyster beds (DDFW 2007). A 5-year functional lifetime for the reef is assumed, due in substantial part to current rates of shell loss and low recruitment (shell half-life, Powell et al. 2007, Table 10). During the last year (after year 5), mortality of remaining oysters occurs.

[c] Shell length is estimated at beginning of age class. Shell length for age class 0 and 1 is based on estimates from the Delaware River. Growth to age class 2 and above is 6.6 mm/yr, based on annual growth for adults on "medium mortality beds" in N.J. (Powell et al. 2007, Table 6). Comparable rates for Del. are not available.

[d] The oyster tissue weight for age class 1 through 5 (juvenile/adult) is assumed to be 0.0113 times the shell length. This is the 2004-2006 average weight:length ratio for adults at Middle Seed beds (Powell et al. 2007, Table 4). Age class 0 weight data are not available for the Delaware River, therefore we utilize spat weight data from the Patuxent River, Maryland.

[e] Ash free dry weight is estimated as 80 percent of dry weight (Bahr and Lanier 1981).

[f] A mid-year average tissue weight is used for determination of the predated or scavenged biomass. Productivity at the end of the first year is the average of age classes 0 and 1, given growth throughout the year. The same ratio is used for later years.

For the “Middle Seed” bed, spat settlement is calculated from the average settlement rate in the high recruitment zone (1,500 spat per bushel) and the projected shell planting density at the “Middle Seed” bed (1,000 bushels per acre). This results in 1.5 million spat per acre, or 371 spat per square meter.

For the “Over the Bar” bed, natural spat settlement on new cultch is estimated at 50 spat per bushel, based on a projected planting density of 2,000 bushels per acre (Powell 2005). This analysis results in 100,000 spat per acre, or 25 spat per square meter.

Natural spat settlement following transport to the “Middle Seed” beds is measured as a ratio of the number of adult oysters (ratio of spat: adults is 0.235; median value medium mortality beds for 1996 to 2006; Powell et al. 2007). For the “Over the Bar” beds, natural spat settlement on existing cultch is estimated at 50 percent of the “Middle Seed” bed (ratio of spat: adults of 0.118).[35] Table 30 presents the expected oyster density by age class for each year.

[35] The spat settlement rate has minimal impact on overall productivity.

Table 30. Oysters by age class.

Year	# of oysters by age class[a] (oysters per m^2) 0	1	2	3	4	5	Consumed Production (g afdw per m^2)[b]	Discounted Production (g afdw per m^2 in 2006)[c]
New Jersey – Middle Seed bed								
0	371						53.3	47.3
1	0	185					7.1	6.1
2	38	0	164				12.6	10.6
3	34	19	0	145			12.7	10.3
4	34	17	17	0	128		13.2	10.4
5	34	17	15	15	0	113	64.0	49
							Total	133.8
Delaware – Over the Bar bed								
0	25						3.6	3.2
1	0	12					0.8	0.7
2	1	0	10				0.9	0.8
3	1	1	0	8			0.8	0.7
4	1	0	0	0	7		0.8	0.7
5	1	0	0	0	0	5	2.9	2.6
							Total	8.6

[a] Age class 0 indicates spat settlement. Beginning in Year 2, additional spat are assumed to settle on the reef and are observed in a spat:oyster ratio of 0.235 for the Middle Seed bed and half that for the Over the Bar bed. In each year following, spat are assumed to settle at the same ratio relative to adult oysters present. The same growth and mortality patterns are assumed as are present for the initial class of settled oysters.

[b] Consumed production for each year is calculated as predated oysters multiplied by the mid-year average weight for each age class. The percentage of tissue consumed by predators and scavengers is 75 percent. Predated oysters for a given age class are calculated as oysters in age class*mortality rate*75 percent, using the age class mortality rates from Table 29 above. Annual consumed production is the sum of (predated oyster biomass)*(mid-year average tissue weight (g afdw)) for each age class.

[c] Discounted production is calculated assuming that reef implementation occurs in 2009, using a discount rate of 3 percent and a base year of 2006 (injury estimates are discounted to 2006). For New Jersey, one third of placement (to address both subtidal and bird injuries) will occur in 2010 and one third in 2011. Discounted productivity values for 2010 and 2011 are 3 percent and 6.1 percent lower, respectively, than for 2009 and are not shown in this table.

Approximately 75 percent of the annual oyster mortality is assumed to be consumed by predators or scavengers, resulting in energy transfer to higher trophic levels (R. Babb, personal communication). Therefore, productivity transferred to higher trophic levels is calculated as: oysters in age class * mortality rate * 75 percent, using the age class mortality rates and weights from Table 29. Each year's production is discounted to 2006, the year to which injury calculations are scaled, and then summed to provide a total estimate of oyster productivity generated by the reef.

In addition to oysters, reef-enhanced epifauna (e.g., mud crabs, grass shrimp, and other small crustaceans such as amphipods, tanaids, and isopods) are expected to be recruited to the reef (Dove and Nyman 1995). For the reef-associated species besides oysters, productivity is assumed to be entirely transferred to higher trophic levels through predation (French McCay et al. 2002).

Table 31 provides the annual cumulative production for both oysters and epifauna (French McCay et al. 2002). The estimated baseline productivity of these species in the potential reef area (shell bottom substrate) is subtracted from the calculations. Detailed assumptions underlying the productivity values are provided in French McCay et al. (2002) (Appendix 4). The estimated recruited annual productivity (above baseline) from French McCay et al. (2002) for grass shrimp, mud crabs, and small crustaceans are 17.94, 18.18, and 2.62 g afdw/m^2, respectively. Over the first year following reef establishment, 50 percent of the recruitment estimate is used. For the following years, the entire recruitment estimate is included.

Total discounted productivity is the sum of the oyster and reef-associated organism productivities (Tables 30 and 31). For the "Middle Seed" beds, the discounted cumulative productivity for the expected lifetime of the reef seeded in 2009 is 309 grams afdw per m^2 (sum of 133.8 g/m^2 and 174.8 g/m^2, or 1,249 kilograms/acre). For 2010 seeding, the productivity is 1,213 kilograms/acre. For 2011 seeding, the productivity is 1,177 kilograms/acre. For the "Over the Bar" beds, the discounted cumulative productivity for the expected lifetime of the reef is 183 grams afdw per m^2 (sum of 8.0 g/m^2 and 174.8 g/m^2, or 748 kilograms per acre). The Trustees propose to split project acreage in a 2:1 ratio between the "Middle Seed" beds and the "Over the Bar" beds, given the higher expected productivity of the "Middle Seed" beds. Given the benthic biomass loss of 4,637 kg and the relative productivities of the two sites (average 1,213 kg afdw/acre for the 2009 to 2011 placements in the "Middle Seed" beds and 748 kg afdw/acre for the "Over the Bar" bed, for a 2:1 weighted average of 1,055 kg afdw/acre), the appropriate scaling for the oyster reef restoration project is 4.5 acres, split as 3 acres in the "Middle Seed" beds (1 acre each in 2009, 2010, and 2011) and 1.5 acres in the "Over the Bar" beds. For project feasibility, it is assumed that these acreages are part of a larger oyster restoration project, as specified under injuries to birds (Section 5.5.3).

Table 31. Discounted annual production of reef-associated organisms transferred to higher trophic levels (g afdw per m^2).

	Year 1 2010[a]	**Year 2 2011**	**Year 3 2012**	**Year 4 2013**	**Year 5 2014**	**Year 6 2015**	**Cumulative Total**
Mud Crabs	8.0	15.5	15.0	14.6	14.2	13.7	81.0
Grass Shrimp	8.1	15.7	15.2	14.8	14.4	13.9	82.1
Small Crustaceans	1.2	2.3	2.2	2.1	2.1	2.0	11.8
Total Prey	17.2	33.4	32.4	31.5	30.6	29.7	174.8

[a] Productivity is calculated based on prey/scavenger consumption for that entire year. These values are for the 2009 start date. Reef-associated biota for the 2010 and 2011 shell placement in New Jersey are estimated to be 3 percent and 6.1 percent lower, respectively, due to discounting.

Probability of Success

While oyster populations in the Delaware River and Bay have decreased over the last several decades, the preferred project would be located in areas of the Delaware River where state agencies have established shell-planting programs that have resulted in large increases in oyster numbers. The site locations would balance salinity and growth requirements with disease and predation, based on the experience and expertise of the state agencies. To avoid accidental or illegal harvest, the likely locations would also be outside of prime commercial oyster areas.

Oyster bed enhancement is generally considered to be the most effective method for supplementing oyster populations and the services they provide (including their role as prey for higher trophic level organisms). Based on the success of existing state oyster programs, the Trustees believe that the probability of success for this project (i.e., the likelihood of successfully producing a functioning oyster reef) is high. By employing both the direct placement and two-step methods, the Trustees are further reducing the risk of project failure associated with use of a single approach.

Performance Measures and Monitoring

Performance measures and monitoring would focus on confirming that the intended acreage (3.0 total acres in the Middle Seed beds and 1.5 acres in the Over the Bar beds) and spat/oyster densities (Table 30) meet the intended target. Confirmation of the size of the created oyster reefs would be a "one-time" monitoring event, occurring as soon as practicable after project implementation. Monitoring of spat/oyster densities would occur annually, beginning immediately following placement of transplanted, seeded cultch (Middle Seed beds) and at the expected peak of natural setting on cultch (Over the Bar beds). Monitoring of spat/oyster densities would continue for a total of 5 years, corresponding to the 5-year project life span assumed in scaling calculations.

If measured spat/oyster densities do not meet the levels assumed in scaling calculations (Table 30), the Trustees would use contingency funds to create additional reef areas and/or relocate the existing reefs to offset the observed shortfall (or to make up for as much shortfall as possible if contingency funds are insufficient to offset it entirely). Although scaling calculations also include the productivity of other benthic invertebrates expected to be enhanced by oyster reef creation (e.g., mud crabs, grass shrimp, and small crustaceans), the Trustees make the simplifying assumption that the density of these biota would track the size of the bed, since their density is assumed in calculations to correspond to the acreage of reef habitat. Thus, confirmation of the area of created oyster reef and oyster densities (and corresponding corrective action, if necessary) would provide sufficient measures of project success, reasonably balancing the need for monitoring with the costs of such efforts.

Approximate Project Costs

Table 32 provides a summary of the costs for creating 3.0 acres of new oyster reef in the Middle Seed beds.[36] Two barge plantings of clam shell, initially in the seed beds and then transferred to the nursery beds, are included. Spatted shell recovery of roughly 67 percent from the initial shell planting is assumed based on past New Jersey projects. A project contingency of 25 percent is shown in Table 47.

Table 32. Summary of Project Costs: Creating a 3.0 acre oyster reef in "Middle Seed" bed area (N.J.).

Cost Element	Per Bushel	Per acre	Cost
Planning and Design			$1,736
Implementation			
Construction Oversight			$2,312
Spat planting at seed beds (1,500 bushels per final acre)			
Clam Shell	$0.85	$1,275	$3,825
Loading Fee	$0.10	$150	$450
Planting (Tug + Barge)	$1.25	$1,875	$5,625
Spat transplant (1,000 bushels recovered per 1,500 planted; planted at 1,000 bushels per acre)			
Re-harvest/Transplant	$1.50	$1,500	$4,500
		Subtotal	*$14,400*
Monitoring			$3,035
		TOTAL*	**$21,484**

* Total project costs do not include contingencies of 25% which are shown in Table 47. Costs assume project is undertaken in conjunction with a larger reef enhancement (Table 41).

[36] Written Communication from Russell M. Babb, Jr., Principal Fisheries Biologist, New Jersey Division of Fish and Wildlife, July 21, 2006. These costs assume that the project is part of a larger effort (>20 acres).

Table 33 provides a summary of the costs for creating 1.5 acres of enhanced oyster reef in the "Over the Bar" beds. One barge planting of oyster shell is included. Costs are based on 2006 shell planting costs in nearby Delaware beds.[37] A 25 percent contingency is shown in Table 47.

Table 33. Summary of Project Costs: Creating a 1.5 acre oyster reef in "Over the Bar" beds (DE).

Cost Element	Per Bushel	Per acre	Cost
Planting at Over the Bar Beds (2,500 bushels per acre)			
Planning and Design			$1,696
Implementation			
Oyster Shell	$0.85	$2,125	$3,188
Planting	$2.75	$6,875	$10,313
Construction Oversight			$557
Monitoring			$2,441
		TOTAL*	**$18,193**

* Total project costs do not include contingencies of 25% which are shown in Table 47. Costs assume project is undertaken in conjunction with a larger reef enhancement (Table 38).

5.5.3 - Restoration of Bird Losses: Habitat Enhancement—Mad Horse Creek, Blackbird Reserve, and Oyster Reef

Trustee estimates of bird injuries attributable to the *Athos* oil spill are summarized in Table 34. Direct injuries totaled 3,308 adult birds, the majority (75 percent) of which were gulls and geese. Additional estimated lost production from mortality and reproductive failure (indirect injury) was 8,561 fledged young.

[37] Personal communication, Richard Cole, Delaware Department of Natural Resources and Environmental Control, Division of Fish and Wildlife. These costs assume that the project is part of a larger effort (>20 acres).

Table 34. Total (direct and indirect) estimated bird injury from the *Athos* oil spill by guild.				
Guild	**Direct Injury (Adults)**	**Discounted Indirect Injury (Fledged Young)**		**Total (Adults and Fledged Young)**
	Died	**Lost Prod. (Mortality)**	**Lost Prod. (Reproductive Failure)**	
Dabbling ducks	605	1,187	577	2,369
Diving ducks	82	163	24	269
Diving birds	64	92	2	158
Gulls	1,072	1,543	331	2,946
Shorebirds	55	79	0	134
Wading birds	10	14	3	27
Swans/geese	1,416	3,369	1,171	5,956
Kingfishers	4	6	0	10
Total	**3,308**	**6,453**	**2,108**	**11,869**

For restoration scaling, guilds are grouped by primary diet (invertebrates, fish/omnivorous, and plants). Invertebrate-consuming guilds include dabbling ducks and shorebirds. Piscivorous or omnivorous consumers include diving ducks and birds, gulls, wading birds, and kingfishers. Primarily herbivorous birds include the swans and geese guild. To compensate for losses to species consuming primarily invertebrates, the Trustees propose restoration of 25.4 acres of wetland habitat in Mad Horse Creek (Figure 13), located in Lower Alloway Creek Township, Salem County, New Jersey. To compensate for losses to piscivorous or omnivorous birds, the Trustees propose creation of approximately 73 acres of oyster reef in the Delaware River. To compensate for losses to primarily herbivorous birds, the Trustees propose creation of 35 acres of wet meadow habitat and 100 acres of grassland habitat at Mad Horse Creek, as well as 41.8 acres of migratory goose habitat in the Blackbird Reserve Wildlife Area in New Castle County.

This restoration approach would benefit coastal bird communities in areas affected by the spill; is consistent with existing federal, state, and local restoration goals for the Delaware River and Bay; and is appropriate in light of the substantial spill-related injuries to birds. This combination of projects also is cost-effective. At Mad Horse Creek and Blackbird Reserve, the land is already government-owned, therefore eliminating the need for easement payments or land purchase. Available information indicates that sediment to be excavated in the marsh habitat targeted for restoration at Mad Horse Creek has low contaminant levels, eliminating the need for expensive treatment and/or off-site disposal. Grassland restoration would take place at Mad Horse Creek, and make use of sediments excavated as part of wetland and wet meadow restoration activities. The oyster reef project takes advantage of a program and resources already in place for on-going oyster restoration efforts throughout the Delaware River.

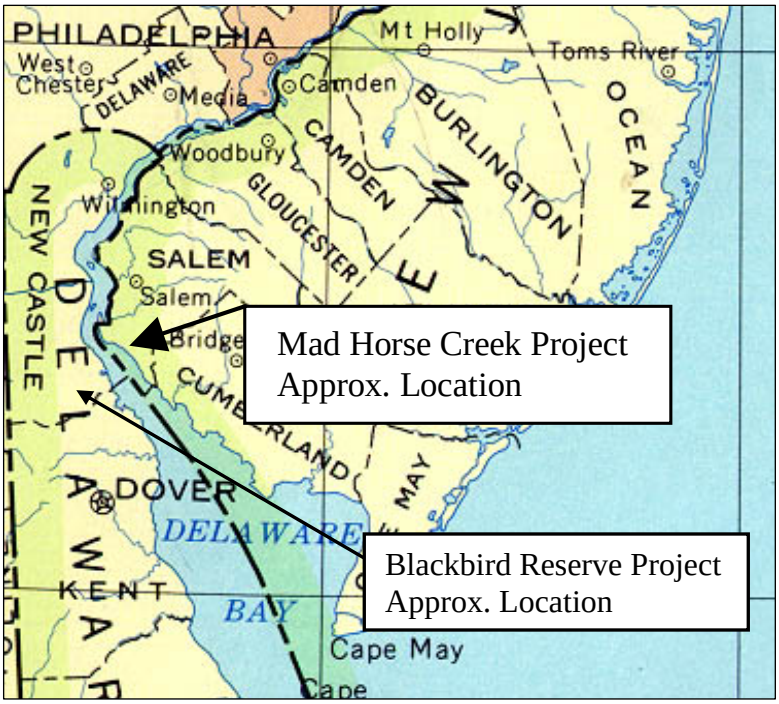


Figure 13. Approximate location of the Mad Horse Creek restoration project.

Project Description - Mad Horse Creek

The proposed restoration site is on the Mad Horse Creek Wildlife Management Area. The 260-acre property contains salt marshes, transitional wetlands (*Phragmites* dominant), agricultural lands, and associated buildings. Past agricultural practices on this property included altering and filling the brackish marsh fringe. These alterations have resulted in a *Phragmites* invasion of the wetland.

NJDEP's Office of Natural Resource Restoration (ONRR) and NOAA are now in the design phase of a tidal and freshwater wetland restoration project (Figure 14). The site location near the Delaware Bay, within tidal waters, would allow for the construction of *S. alterniflora* habitat at appropriate elevations. Restoration would be accomplished through the removal of fill material and lowering the marsh elevation so that tidal inundation can occur. Wet meadow habitat also would be created through excavation at upland locations on-site. Options for disposal of the excavated sediment from restored marsh and wet meadow areas include on-site and off-site placement, with on-site being the most cost effective. On-site disposal also creates grassland habitat that would help compensate for *Athos* bird injuries.[38]

The State of New Jersey would serve as the LIT for this project, with Trustee Council oversight.

[38] While the Mad Horse Project also will involve the creation of woodland habitat, this project component will not generate benefits that compensate for *Athos*-related injuries. Costs for woodland habitat creation therefore are excluded from cost estimates developed for *Athos*-related restoration at Mad Horse Creek.

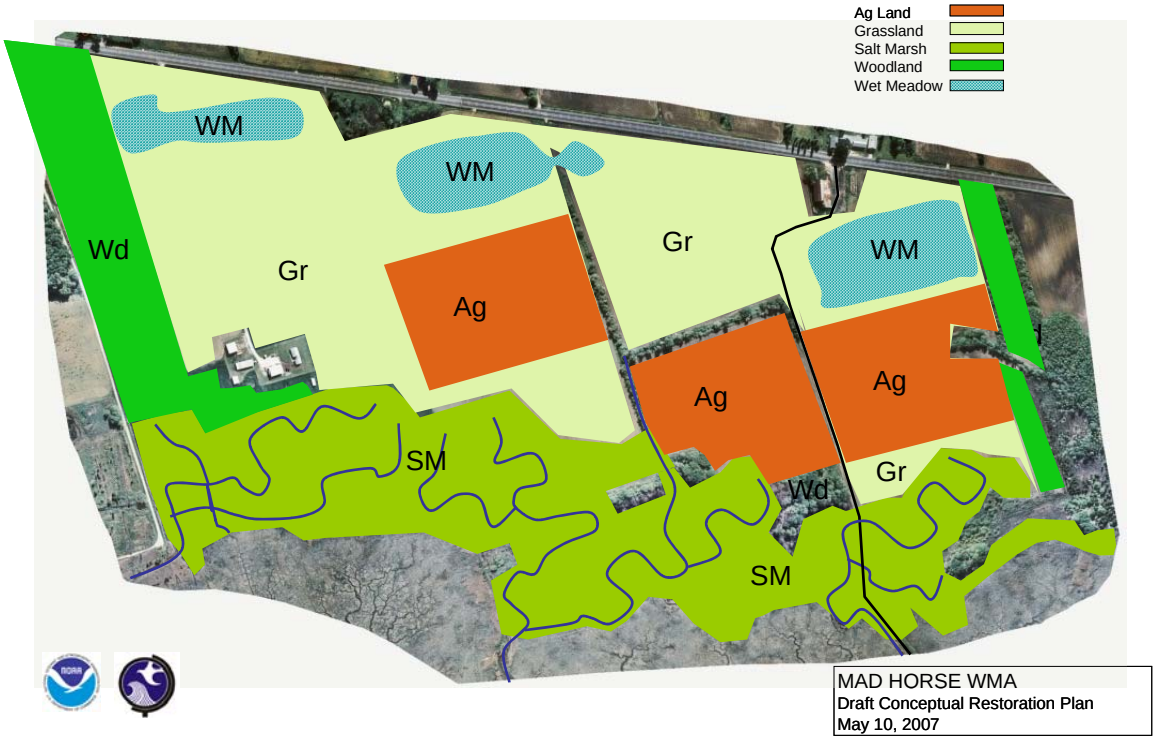


Figure 14. Mad Horse Creek conceptual restoration plan.

Project Description - Blackbird Reserve

The proposed site of this pond, pasture, and agricultural food plot project is within the state-owned Blackbird Reserve Wildlife Area in southern New Castle County, Delaware. The 535-acre site is predominantly forested (71.4 percent), with 152.9 acres (28.6 percent) in open agricultural lands. In an effort to maintain habitat heterogeneity and provide wildlife habitat value, the Division of Fish and Wildlife proposes restoration of these agricultural lands into a combination of forested areas, shallow wetland ponds, wildlife pastures, and agricultural food plots. The latter three habitat types would be restored to provide suitable migratory goose habitat as part of *Athos* restoration efforts (Figure 15). Existing lowland areas would be excavated to create two shallow wetland ponds surrounded by managed pastures designed to attract migratory geese. In addition, areas adjacent to the pastures would use agricultural practices to create wildlife food plots also designed to attract migrating geese. In total, approximately 2.2 acres of ponds, 16 acres of pasture, and 23.6 acres of food plots would be established.[39]

The slopes of the shallow wetland ponds would be planted in beneficial wetland plants and the pastures would be planted with cool season grasses, including white clover and a fescue mix (creeping red and chewing). The wildlife food plots would be established using agricultural practices and would be planted in corn, soybean, or winter wheat; however, no more than 80

[39] The active agriculture component is 23.6 acres; 20 percent, or 4.7 acres, will be left unharvested as standing crop for geese.

percent of the crop would be removed, providing both food and feeding habitat for migrating geese. The remaining 20 percent of crop left standing (4.7 acres) would be distributed along the perimeter of the fields to improve vegetative erosion control, as well as in thin strips or small blocks within the fields providing ideal winter feeding habitat for migrating geese.

The State of Delaware would serve as LIT for this project, with Trustee Council oversight.

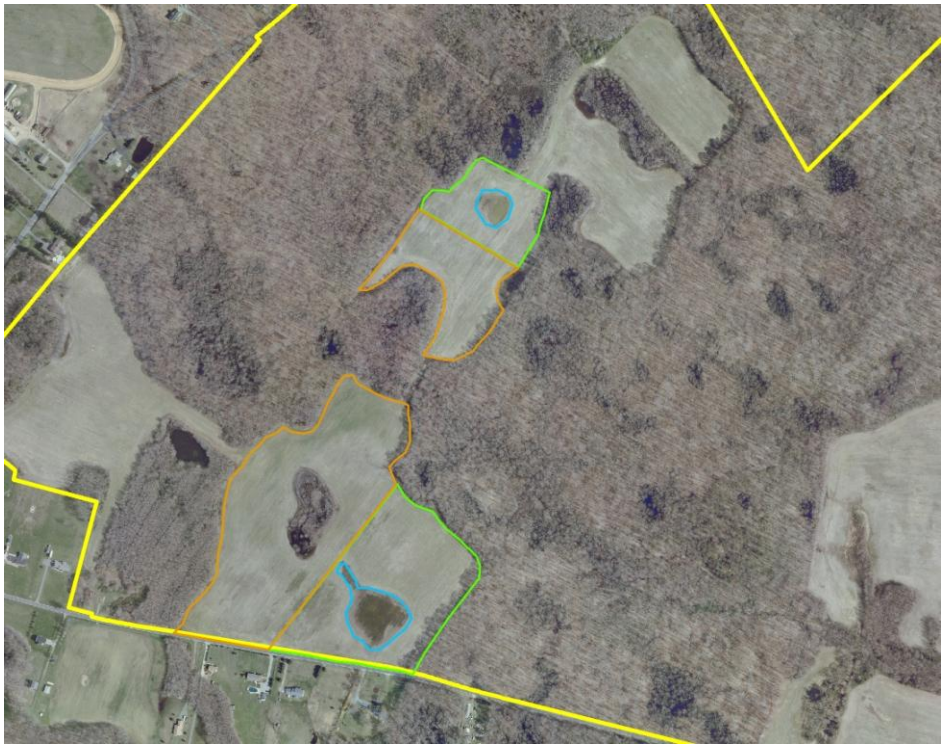


Figure 15. Preferred restoration projects at Blackbird Reserve. The targeted ponds are outlined in blue, the pasture areas in neon green, and the agricultural fields/wildlife food plots in orange.

Project Description - Oyster Reef

The Trustees propose to create 73.5 acres of oyster reef through both a direct placement project at a rate of roughly 2,000 bushels/acre in the Over the Bar beds on the Delaware side of the river and a recruitment/placement project in New Jersey waters on the Delaware River (see Section 5.5.2). Both NJDEP and DNREC have established programs that create and enhance oyster beds either by direct placement of shell for natural spat settlement or a two-step process whereby shell is placed in high spat recruitment areas and then moved to areas that exhibit higher spat growth and survival. As described below, this project includes both methods to reduce the risk of project failure.

The direct placement method is proposed at the “Over the Bar” oyster beds on the Delaware side of the river (Figure 12). Shell would be placed in this historic seed bed, which currently has limited shell bottom and, as a result, low natural spat settlement rates and few adult oysters.

Placement of shell during the spring and early summer would enhance the area, allowing settlement of oyster spat and recruitment of other reef-associated epifauna. Consistent with established methods employed by DNREC, the site would be seeded at a rate of 2,000 bushels/acre.

The two-step process is proposed in New Jersey portions of the River. Consistent with established oyster enhancement techniques in New Jersey, about 1,500 bushels of shell per acre would be placed in historic oyster bed areas with high spat recruitment/settlement rates (Figure 12). Three to six months following initial shell placement, spatted cultch would be harvested and transported upstream to *Athos* spill-exposed areas (e.g., the "Middle Seed" bed) (Figure 12) with lower natural mortality rates (particularly lower disease rates due to lower salinity). Shell density for replanting would be 1,000 bushels/acre.

The Delaware project would be implemented in the spring or early summer of 2009. The New Jersey reef creation would be divided between 2009, 2010, and 2011, with 17 acres created the first year and 16 in each of the two subsequent years. Oyster survival on the transplanted reef would be 5 years, and no harvesting of the oysters would be allowed during the initial 5-year period.

The States of Delaware and New Jersey would serve as LITs for this project, with Trustee Council oversight.

Restoration Objectives

The objective is to implement habitat restoration projects to restore an equivalent number of adult and juvenile birds lost due to the spill (Table 34) through the enhancement or creation of wetland, pond, wet meadow, grassland, food plot, and oyster reef habitat. The resulting increase in invertebrate and fish biomass (wetland habitat, oyster reef) and upland vegetation (wet meadow, food plot, and grassland habitat) would serve as food sources that, once adjusted to account for trophic levels and ecological transfer efficiencies, can reasonably be expected to enhance bird biomass by an amount sufficient to offset documented bird losses.

Scaling Calculations – General

Scaling calculations include both direct and indirect injuries (i.e., direct mortality from the spill as well as indirect mortality due to lost productivity). Injuries are scaled by guild based on approximate weight and diet of the birds (Table 35).

To estimate the amount of restored habitat required to offset documented injuries, using the approach in French McCay and Rowe (2003), bird loss must first be converted from an "individuals lost" metric to a biomass basis (i.e., kilograms of bird biomass lost). This conversion is made by multiplying the numbers of birds lost by the estimated weight per bird. For direct injury, the adult weight is used. For indirect injuries (lost fledgling production), the juvenile

weight is used.[40] Bird biomass lost is then "transferred" into an equivalent amount of estuarine wetland secondary productivity (for dabbling ducks and shorebirds), oyster reef secondary productivity (for piscivorous/omnivorous birds), or vegetative primary productivity (for geese and swans) based on energy transfer efficiencies between trophic levels (i.e., between productivity generated by the restored marsh or oyster reef and the potential contribution of this productivity to bird biomass, taking intervening consumers into account). Transfer ratios were obtained from French McCay et al.'s (2002) review of relevant ecological efficiency literature. Transfer ratios used for *Athos* scaling calculations also are consistent with ratios used in the Final Restoration Plan and Environmental Assessment developed for the 7 April 2000 oil spill at Chalk Point on the Patuxent River, Maryland (NOAA et al. 2002). In the final step of the scaling analysis, the area of enhanced oyster reef, restored wetland, wet meadow, food plot, or grassland habitat required to offset specified injuries is calculated based on productivity information per unit area for these habitats obtained from relevant scientific literature. Species-specific scaling calculations are described in more detail below.

Table 35. Overview of restoration scaling for bird losses.

Guilds	Direct Injury	Indirect Injury	Selected Species[a]	Weight[b] (kg) [Adult/ Juvenile]	Total Biomass[c] (kg) [Adult/ Juvenile]	Primary Diet	Restoration Project
Dabbling ducks	605	1,764	Mallard	1.21/1.09	732/1,923	Inverte-brates	Marsh
Diving ducks	82	187	Bufflehead	0.37	100	Fish	Oyster Reef
Diving birds	64	94	Double-crested cormorant	2.3	363	Fish	Oyster Reef
Gulls	1,072	1,874	Ring-billed gull	0.53/0.36	568/675	Fish/ Omnivor-ous	Oyster Reef
Shorebirds	55	79	Sanderling	0.06	8.0	Invertebr ates	Marsh
Wading birds	10	17	Great blue heron	2.3	62	Fish	Oyster Reef
Swans and geese	1,416	4,540	Canada goose	3.96/2.20	5,607/9,988	Plants	Wet Meadow/ Grassland
Kingfishers	4	6	Belted kingfisher	0.15	1.5	Fish	Oyster Reef

[a] The representative species is selected based on the most prevalent species for each guild represented in the recovered oiled birds following the spill, as reported in the Preassessment Data Report (NOAA 2006). For shorebirds, for which no oiled birds were recovered, the sanderling is chosen as a mid-weight bird spotted during bird observations.
[b] Weights are based on data from the British Trust for Ornithology (BTO), with the exception of great blue herons, which are based on data from the Cornell Lab of Ornithology. When both male and female weights are available, an average is used. For

[40] For several of the smaller guilds, representative juvenile weights were not available; however, these species represent a very small fraction of the overall biomass.

mallards, gulls, and Canada geese, juvenile weights are available and included in indirect injury biomass calculations. Ring-billed juvenile weight is assumed equal to BTO juvenile weight estimates for common gulls (adult common gulls average 0.41 kg, slightly smaller than ring-billed gulls). Juvenile (fledgling) weight for Canada geese is the average reported in LeBlanc (1987) for Moffit's Canada Goose (*B. c. moffitti*), a subspecies similar in size to the Atlantic Canada Goose (*B. c. canadensis*)
[c] Total Biomass is calculated as the sum of direct injury multiplied by adult weight and indirect injury multiplied by juvenile weight (if available). If juvenile weight is not available, total biomass is weight per bird multiplied by the sum of direct and indirect injury.

Scaling Calculations - Invertebrate Consumers

Scaling calculations for dabbling ducks and shorebirds are summarized in Table 36. Estimates of average adult and juvenile bird weights were based on data available from the British Trust for Ornithology.[41] For these guilds, the Trustees used secondary production as the "base" measure of productivity, from which adjustments for trophic transfer efficiencies are made. From a trophic level perspective, secondary production is "closer" to invertebrate consumers and so is an appropriate starting point for the scaling analysis. For these guilds, use of primary production as the "base" measure of productivity is less preferable since this would require an additional set of assumptions regarding transfer efficiencies from primary to secondary production. The invertebrate production of an improved Mad Horse Creek marsh is also a reasonable approximation of the prey that these species consume.

As indicated in Table 36, the Trustees assumed an ecological efficiency "transfer ratio" of 2 percent for birds feeding on invertebrate prey (i.e., 50 kg of invertebrate prey biomass is needed to generate 1 kg of bird biomass). As noted above, this assumption is consistent with estimates developed in French McCay et al.'s (2002) review of relevant ecological efficiency literature and scaling calculations conducted in the Final Restoration Plan and Environmental Assessment developed for the 7 April 2000 oil spill at Chalk Point on the Patuxent River, Maryland.

Table 36. Scaling calculations: Invertebrate consumers.

Guild	Selected Species	Biomass (kg) (Table 35)	Ecological Efficiency[a]	Compensatory Secondary Production Required[b] (kg dw)	*Spartina* Marsh Secondary Productivity[c] (kg dw per acre)	*Spartina* area required (acres)
Dabbling Ducks	Mallard (Adult/ Direct Injury)	732	2%	8,053	1,153	7.0
Dabbling Ducks	Mallard (Juvenile/ Indirect Injury)	1,923	2%	21,150	1,153	18.3
Shorebirds	Sanderling	8.0	2%	88	1,153	0.1
					Total	**25.4**

[a] Ecological efficiencies are calculated relative to benthic infaunal detritivores and omnivores, as summarized in French McCay and Rowe (2003) and their review of relevant literature.
[b] Compensatory Production Required (kg dw)= Weight of Birds Lost (kg ww)*0.22 (kg dw/kg ww) / Ecological Efficiency (%). Conversion from dry weight to wet weight assumes dry weight = 22% of wet weight (French McCay and Rowe 2003).

[41] For more information on the British Trust for Ornithology, see Robinson (2005). Data for the great blue heron are from the Cornell Lab of Ornithology (2003) (http://www.birds.cornell.edu/AllAboutBirds/BirdGuide/).

[c] As estimated in French McCay and Rowe (2003), assuming a benthic faunal productivity of 20.8 (g dw/m^2-yr), 50-year functional life for the created marsh, restoration beginning 3 years after the spill, and 15 years for the created marsh to reach maximum functionality (following a logistic recovery path), discounted at 3 percent annually. Injury is discounted to 2006, with restoration planned to begin by 2010. The calculations are modified for a maximum service level of 85 percent based on monitoring requirements that at least 85 percent of the project area be successfully colonized with either targeted species or similar, native species consistently over a 3-year period (NJDEP 2000). French McCay and Rowe (2003) is based on a broad review of *Spartina* marsh secondary productivity, primarily from southern New England. *Athos* scaling calculations assume negligible contributions to benthic productivity from the existing habitat targeted for restoration. Conversion from hectares based on 1 hectare = 2.47 acres.

Application of this 2 percent ecological efficiency transfer ratio to duck and shorebird injuries and conversion from wet weight to dry weight (assuming dry weight is 22 percent of wet weight as applied in French McCay and Rowe (2003)) results in a restoration requirement of 29,239 kg (dry weight) of compensatory benthic production needed to address duck and shorebird losses.[42]

The Trustees assumed that a restored *Spartina* marsh produces approximately 1,153 kg (dry weight) of discounted benthic productivity per acre, consistent with French McCay and Rowe (2003). This estimate assumed a 50-year functional life for the restored marsh, with restoration beginning in 2009 and maximum functionality achieved in 15 years (following a logistic recovery path prior to that point).[43] French McCay and Rowe (2003) estimates are based on a broad review of *Spartina* marsh secondary productivity, primarily from marshes in southern New England. Trustee scaling calculations conservatively assumed negligible contributions to benthic productivity from the existing degraded and filled habitat targeted for restoration.

As shown in Table 36, the calculated biomass requirement (29,239 kg dw) divided by the productivity per acre (1,153 kg dw/acre) results in a restoration requirement of 25.4 acres to offset dabbling duck and shorebird guild losses.

Scaling Calculations - Piscivorous/Omnivorous Species

Piscivorous and omnivorous species were scaled based on trophic transfer of the invertebrate productivity of an oyster reef. French McCay and Rowe (2003) provide a basis for scaling piscivorous and omnivorous species to invertebrate productivity, with an ecological efficiency of 0.4 percent.[44] To estimate the amount of additional benthic macroinvertebrates available to predators such as fish through creation of an oyster reef, the Trustees relied on the productivity model created for an oyster reef restoration project in the Patuxent River (French McCay et al.

[42] 29,239 kg dw secondary prod. = ((732 kg ww + 1,923 kg ww + 8.0 kg ww) / 0.02 transfer efficiency) * 0.22 kg dw/kg ww.

[43] The French McCay and Rowe (2003) productivity estimate assumes restoration begins 3 years after the spill. For the *Athos* spill, all injuries and restoration projects are discounted to 2006. Restoration is assumed to begin in 2009, 3 years after injury, as in the calculations in French McCay and Rowe (2003).

[44] The ecological efficiency represents a two-step trophic transfer. Birds consuming fish have an ecological efficiency of 2 percent; fish consuming invertebrates have an ecological efficiency of 20 percent (French McCay et al. 2002). The product of the efficiencies (0.4 percent) represents birds scaled to invertebrate production.

2002), augmented by site-specific data from the N.J./Del. oyster restoration program.[45] Scaling calculations for piscivorous and omnivorous species are summarized in Table 37. The total biomass requirement of 77,851 kg afdw was split between the 2009-2011 Middle Seed bed projects and the 2009 Over the Bar project. Given the average productivity of 1,055 kg afdw/acre, a final reef size of 73.5 acres is required, split into 49 acres at the Middle Seed bed project and 24.5 at the Over the Bar bed.

Table 37. Scaling calculations: Piscivorous/omnivorous consumers.

Guild	Selected Species	Biomass (kg) (Table 35)	Ecological Efficiency[a]	Compensatory Secondary Production Required[b] (kg afdw)
Gulls	Ring-billed gull (Adult/ direct injury)	568	0.4%	24,999
Gulls	Ring-billed gull (Juvenile/ indirect injury)	675	0.4%	29,684
Diving Ducks	Bufflehead	100	0.4%	4,379
Diving Birds	Double-crested cormorant	363	0.4%	15,990
Wading Birds	Great blue heron	62	0.4%	2,732
Kingfishers	Belted kingfisher	1.5	0.4%	66
Total Compensatory Biomass				**77,851[c]**
Average discounted cumulative productivity (kg afdw/acre) [based on 2:1 split between Middle Seed bed and Over the Bar bed]				1079
Acres of Oyster Reef				**72**
Acres at Middle Seed bed /Over the Bar bed				**48/24**

[a] Ecological efficiencies are calculated relative to benthic infaunal detritivores and omnivores, as summarized in French McCay and Rowe (2003) and their review of relevant literature. Birds consuming fish have an ecological efficiency of 2 percent; fish consuming invertebrates have an ecological efficiency of 20 percent. The product of the efficiencies (0.4 percent) represents piscivorous birds scaled to invertebrate production.

[b] Compensatory Production Required (kg afdw)= Weight of Birds Lost (kg ww)*0.22 (kg dw/kg ww)*0.8 (kg afdw/kg dw) / Ecological Efficiency (%). Conversion from dry weight to wet weight assumes dry weight = 22 percent of wet weight (French McCay and Rowe 2003). Conversion from dry weight to ash free dry weight (afdw) assumes afdw = 80 percent of dry weight (Bahr and Lanier 1981).

[c] Values do not exactly sum to total due to rounding.

Scaling Calculations - Herbivorous Species

The Trustees modified the scaling approach used for other guilds to estimate compensation required to offset geese losses. Estimates of average adult Canada geese weights were obtained from information provided by the British Trust for Ornithology (Robinson 2005). Average

[45] For more detailed calculations on oyster reef productivity, please see Section 5.5.2.

juvenile weights were obtained from Leblanc (1987).[46] Geese are herbivores and consume plant biomass directly. While wetland restoration is an appropriate and effective approach for generating secondary (benthic) productivity utilized by coastal bird communities, there are more cost-effective approaches for generating the primary production (i.e., vegetation) likely to be consumed by geese, particularly since they frequently feed in more upland areas. In light of these considerations, the Trustees scaled geese losses to restoration of wet meadow, pond, and pasture/grassland habitat.

For these reasons, the Trustees used primary production as the "base" measure of productivity, from which adjustments for trophic transfer efficiencies are made. As indicated in Table 38, the Trustees assumed an ecological efficiency "transfer ratio" of 0.03 percent for birds feeding on a mixture of *Spartina* and microalgae typical of northeast salt marshes (French McCay et al. 2002), i.e., approximately 3,333 kg of plant biomass is needed to generate 1 kg of bird biomass. This assumption is consistent with a review of relevant ecological efficiency literature conducted in the Final Restoration Plan and Environmental Assessment developed for the 7 April 2000 oil spill at Chalk Point on the Patuxent River, Maryland. Application of this 0.03 percent ecological efficiency transfer ratio to geese injuries and conversion from wet weight to dry weight (assuming dry weight is 22 percent of wet weight as applied in French McCay and Rowe (2003)) results in a restoration requirement of approximately 4.1 million kg and 7.3 million kg (dry weight) of compensatory primary production needed to address direct and indirect injuries to geese and swans, respectively.

Because of the magnitude of geese injuries and size limitations inherent to specific projects, compensation for injuries to geese is spread over several suitable projects. The first is a wet meadows project at Mad Horse Creek (35 acres); the second is a pond/pasture/food plot enhancement project in New Castle County, Delaware (41.8 acres), and the third is a grasslands project at Mad Horse Creek (100 acres).

The Mad Horse Creek areas for wet meadows and grassland projects, as well as the proposed area at Blackbird Reserve, are currently in active agriculture. The baseline productivity—the productivity currently consumed by herbivorous birds—is assumed to be the agricultural waste following harvest. Several studies have investigated the availability of this material to birds, specifically migratory waterfowl and geese. Corn is chosen as the proxy species for agricultural areas, given its prevalence and readily available data. The average of three reported values of waste corn following standard harvest practices is 131 kg per acre (Baldassarre and Bolen undated; Warner et al. 1989; Ringelman 1990). The discounted net productivity is 3,170 kg per acre, for the 50-year lifespan used for other herbivorous bird projects. This value is subtracted from the discounted net productivity for each of the following habitats, in order to estimate the additional productivity that will result from the projects.

For the wet meadows project at Mad Horse Creek, the Trustees assumed that restoration would begin in 2010, and that a restored wet meadow habitat would cumulatively produce approximately 129,536 kg (dry weight) of additional primary productivity per acre over the 50-

[46] Juvenile (fledgling) weight is the average reported in LeBlanc (1987) for Moffit's Canada Goose (*B. c. moffitti*), a subspecies similar in size to the Atlantic Canada Goose (*B. c. canadensis*).

year project duration assumed for scaling purposes. To develop this estimate, wet meadow annual primary productivity was calculated based on the average net annual productivity of several sedges and rushes in the United States (Mitsch and Gosselink 1986). Four common species (*Carex atheroides, Larex lacustris, Juncus effusus,* and *Scirpus fluviatilis*) were included, for a net annual productivity of 7,155 kg per acre. Scaling calculations assume that a maximum vegetation productivity of 85 percent is reached in 5 years, based on NJDEP mitigation requirements that specify a target vegetation requirement of 85 percent, with less than 10 percent invasive plants.[47]

The proposed site of the pond/pasture/food plot project is the Blackbird Reserve Wildlife Area in New Castle County. Restoration would begin in 2009 and is expected to produce an average increase in primary productivity of 100,909 kg (dry weight) per acre over the lifetime of the project, averaged across all habitat types. The pasture section would be planted with white clover, creeping red fescue, and chewing fescue. For scaling purposes, the productivity of the pasture areas is assumed to be the average of the three species, resulting in an increase in net primary productivity of 112,387 kg per acre for pasture. According to published values, the productivity range for white clover is between 1,800 and 2,800 kg per acre (average 2,300), while creeping red fescue ranges from 6,110 to 6,920 kg per acre (average 6,440) and chewing fescue from 5,670 to 6,440 kg per acre (average 5,790).[48] The three species are averaged to provide a productivity of 4,860 kg per acre of pastureland. The net productivity over the project lifetime is calculated assuming a 50-year project lifespan, 50 percent productivity in the first year, and 100 percent in the following 49 years.

For the pond/wetland component, the Trustees average the estimated primary productivity of small ponds with wet meadows, to account for ecological benefit arising from phytoplankton, algae, and aquatic vegetation in the pond as well as vegetation on the shallow sloped banks. For the wetland vegetation on the sloped banks, the wet meadow value derived above for Mad Horse Creek is applied. For ponds, a primary productivity of 1,805 kg per acre is used, which incorporates phytoplankton and submerged macrophytes (Russo 1978). The net pond productivity over the project lifetime is calculated assuming a 50-year project lifespan, 50 percent productivity in the first year, and 100 percent in the following 49 years, resulting in an additional lifetime productivity of 86,648 kg per acre.

In the agricultural area, 23.6 acres of agricultural food plots would be planted. Of the acreage, 20 percent (4.7 acres) would be left unharvested. For the agricultural standing crop component, corn is chosen as a proxy crop. The 2003-2007 average yield for corn in New Castle County is 137.7 bushels per acre (USDA NASS undated). Given a standardized weight of 56 pounds per bushel (7 CFR §810.404) and average moisture of 15.5 percent, the net annual productivity is 3,320 kg per acre. The additional productivity above baseline over the lifetime of the project is 68,508 kg

[47] Because this restoration project is focused solely on producing herbaceous vegetation suitable for geese and swans, not complete marsh structure or benthic invertebrate communities, the scaling calculations assume maximum productivity by the end of the 5-year monitoring program.

[48] White clover: Duke 1983 and UCSAREP undated; Red chewing fescue and creeping fescue: Chastain et al. 2002.

per acre. The net productivity over the project lifetime is calculated assuming a 50-year project lifespan and 100 percent productivity beginning in the first year since the land is currently in agricultural use.

For the grassland component of Mad Horse Creek, the lifetime additional productivity is estimated as 45,727 kg per acre, based on a 2010 start date. The yearly productivity estimate of 2,120 kg per acre is based on annual aboveground net primary production from a grassland site in Osage, Kansas, most similar in rainfall and average temperature to southern New Jersey during a multi-year study (Sims and Singh 1978). Grassland scaling calculations assume 50 percent of "full" productivity in the first year followed by full productivity for the ensuing 49 years.

Table 38. Scaling calculations: Herbivorous consumers.

Guild	Selected Species	Biomass (kg) (Table 35)	Ecological Efficiency[a]	Compensatory Primary Production Required[b] (kg dw)
Swans and geese	Canada geese (Adult/Direct Injury)	5,607	0.03%	4,112,064
Swans and geese	Canada geese (Juvenile/Indirect Injury)	9,988	0.03%	7,324,533
			Total	**11,436,597**

[a] Ecological efficiencies are calculated relative to benthic infaunal detritivores and omnivores, as summarized in French McCay et al. (2002).

[b] Compensatory Production Required (kg dw)= Weight of Birds Lost (kg ww)*0.22 (kg dw/kg ww) / Ecological Efficiency (%). Conversion from dry weight to wet weight assumes dry weight = 22% of wet weight (French McCay and Rowe 2003).

Project	Net Productivity (kg dw/acre)[c]	Available Acreage (acres)	Available Primary Production (kg dw)
Wet Meadow (Mad Horse Creek)[d]	129,536	35	4,533,761
Managed Pasture (Blackbird Reserve)[e]	112,387	16	1,798,195
Pond (Blackbird Reserve)[f]	86,648	2.2	190,625
Agricultural Crops (Blackbird Reserve)[g]	68,508	4.7	321,990
Grasslands (Mad Horse Creek)[h]	45,727	100	4,572,664
		Total Primary Productivity	**11,412,855**

[c] All calculations assume 50 years of productivity and a discount rate of 3 percent annually. The baseline productivity for all areas is set to waste corn, due to current agricultural use, and the discounted net productivity (3,170 kg dw/acre) has been subtracted from the net productivity for each habitat type. Discounted net productivity calculations are shown in Appendix 4.

[d] Wet meadow annual primary productivity is based on representative sedges and rushes (Mitsch and Gosselink, 1986). Scaling calculations assume that a maximum vegetation productivity of 85 percent is reached in 5 years, based on NJDEP mitigation requirements. Project start date is 2010.

[e] Managed pasture is calculated as the average annual productivity of the three species planted in the area (white clover, creeping red fescue, and chewing fescue). Pasture scaling calculations assume 50 percent of "full" productivity in the first year followed by full productivity for the ensuing 49 years. Project start date is 2009.

[f] Pond productivity is calculated as the average of pond productivity (phytoplankton and aquatic vegetation) and wet meadow productivity, due to the combination of pond and vegetated banks. For the pond productivity, the first year is calculated at 50 percent of full productivity, followed by full productivity for the ensuing 49 years. Project start date is 2009.

[g] Agricultural productivity is based on corn as a proxy, given that it is a likely crop in the area. Annual productivity of corn per acre for Delaware agricultural lands is used, along with standardized assumptions regarding the weight of corn per bushel and the moisture content. For the agricultural productivity, full productivity is assumed for the entire 50 years, given the current use as agricultural lands. Project start date is 2009.

[h] Grassland primary productivity is conservatively assumed equal to the highest annual productivity observed at a grassland site (Osage, Kansas) most similar in rainfall and average temperature to southern New Jersey during a multi-year study (Sims and Singh 1978). Grassland scaling calculations assume 50 percent of "full" productivity in the first year followed by full productivity for the ensuing 49 years. Project start date is 2010.

Probability of Success

Restoration of wetlands, meadows, food plots, and grasslands is a feasible and proven technique with established methodologies and documented results. Local, state, and federal agencies have successfully implemented similar projects in this region. The Mad Horse Creek and Blackbird Reserve projects are located on land already owned by the government. For these reasons, the Trustees believe that this project has a high likelihood of success.

While final details of the marsh restoration projects remain to be fully developed, the Trustees would carefully monitor plant handling and installation to ensure that appropriate guidelines are being followed. With respect to revegetation efforts, all plant material would be inspected to

ensure that it is healthy and vigorous, and would be protected during mobilization from drying and physical damage. Container grown plants would be treated with a slow-release fertilizer at the time of planting. Replanting would occur if a significant number of plants die.

Oyster bed enhancement is generally considered to be the most effective method for supplementing oyster populations. The ongoing program in the Delaware River has resulted in large increases in oyster numbers, particularly based on the size of the projects relative to the overall area of nursery beds. The probability of success for this project (i.e., the likelihood of successfully producing a functioning oyster reef) is high.

Performance Measures and Monitoring

Mad Horse Creek

Project performance at Mad Horse Creek would be assessed by comparing quantitative monitoring results to predetermined performance standards. These standards would be partially based on guidelines established by the NJDEP for assessing wetland mitigation projects (Appendix 4), as well as other published scientific literature. Restored habitats would be monitored once a year, in early fall, for five full growing seasons, then in years seven and ten. Monitoring once per year differs from language in the draft DARP/EA, which called for twice per year for five years. The extension of monitoring at Mad Horse through year ten would allow for more accurately gauging success of the project in meeting compensatory requirements. Monitoring assessments would include documentation of hydrologic regime, soil characteristics, plant species present, and confirmation of planned site grading and elevation. At the end of the monitoring period, a survival rate of 85 percent of planted vegetation (and/or similar native vegetation) should be documented; less than 10 percent of plant species should be characterized as non-native, invasive, or noxious. At the conclusion of monitoring, the created wetland areas should be delineated using federal standards and the final acreage corroborated with compensatory requirements.[49]

The monitoring program for this project would use these standards to determine whether the project goals and objectives have been achieved, and whether corrective actions are required to meet the goals and objectives. In the event that performance standards are not achieved, or monitoring suggests unsatisfactory progress toward meeting established performance standards, corrective actions would be implemented. Possible corrective actions include regrading the area to proper elevations and replanting appropriate vegetation. Any necessary corrective actions would be funded by the contingency component of the project costs (Table 47).

Blackbird Reserve Wildlife Area

Project performance at Blackbird Reserve would be assessed by evaluation of the acreage allocated to each use (pasture, agricultural, pond). For the pasture plantings, monitoring would

[49] Specifically, wetlands will be delineated using the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (Federal Interagency Committee for Wetland Delineation 1989).

include documentation of the acreage and evaluation of the species. A survival rate of 85 percent of planted vegetation (and/or similar native vegetation) should be documented; less than 10 percent of plant species should be characterized as non-native, invasive, or noxious; and the entire area should be vegetated. For the agricultural area, monitoring would include documentation of the acreage left unharvested for wildlife use at the end of the season. In the pond area, monitoring would entail documentation of the overall acreage and evaluation of the bank vegetation. An assessment would be made to determine whether sufficient vegetation is present to stabilize the banks. If the acreages are less than specified in the plan, modifications would be made to planting and to the agreement with the farmer for the agricultural lands, as necessary. Any necessary corrective actions would be funded by the contingency component of the project costs.

Oyster Reef

Performance measures and monitoring for the oyster reef would focus on two key parameters that function as a trigger for use of contingency funds (if necessary). First, the Trustees would confirm that the intended acreage of oyster reef is successfully created. As noted previously, scaling calculations suggest that approximately 73.5 acres of created oyster reef (approximately 49 acres in the Middle Seed beds and 24.5 acres in the Over the Bar beds) are needed to offset *Athos*-related injuries to piscivorous and omnivorous birds. Second, the Trustees would measure spat/oyster densities on created oyster reefs. This parameter also is a key driver of scaling results.

Confirmation of the size of the created oyster reefs would be a "one-time" monitoring event, occurring as soon as practical after project implementation. Monitoring of spat/oyster densities would occur annually, beginning immediately following placement of transplanted, seeded cultch (Middle Seed beds) and the expected peak of natural setting on cultch placed by the Trustees (Over the Bar beds). Monitoring of spat/oyster densities would continue for a total of 5 years, corresponding to the 5-year project lifespan assumed in scaling calculations.

Annual monitoring would be performed by Dr. Powell and colleagues at Haskins Laboratory of Rutgers University. The *Athos* sites would be integrated into regular monitoring conducted by the laboratory, affording cost efficiencies while securing the professional expertise of Dr. Powell and his staff. The number of spat or oysters would be determined using divers over a 3-day period each year. For every 25 acres of created reef, 3 transects would be established, with 12 quarter-meter quadrat collection sites per transect. Divers would collect shell and established biota within each of these quadrats and place them in bags. The specimens would then be transported on-shore where they would be counted and identified in the laboratory.

If measured spat/oyster densities do not meet the levels assumed in scaling calculations as described under scaling for subtidal injuries, the Trustees would utilize contingency funds to create additional reef areas and/or relocate the existing reefs to offset the observed shortfall (or to make up for as much shortfall as possible if contingency funds are insufficient to offset it entirely). Although scaling calculations also include the productivity of other benthic invertebrates expected to be enhanced by oyster reef creation (e.g., mud crabs, grass shrimp, and small crustaceans), the Trustees make the simplifying assumption that the density of these biota would track the size of the bed, since their density is assumed in calculations to correspond to the

acreage of reef habitat. Thus, confirmation of the area of created oyster reef and oyster densities (and corresponding corrective action, if necessary) would provide sufficient measures of project success, reasonably balancing the need for monitoring with the costs of such efforts.

Approximate Project Costs

Table 39 provides a summary of expected costs for restoring 25.4 acres of wetland habitat, 35 acres of wet meadow habitat, and 100 acres of grassland habitat at Mad Horse Creek to compensate for injuries to invertebrate-consuming and herbivorous birds. Table 47 shows the 25 percent contingency calculated for each project. The location and disposition of Mad Horse Creek would make the construction costs low relative to most other potential restoration sites. Relatively low project costs result from the fact that both properties are government-owned (thus no need to purchase property or easements) and the expectation, based on available information, that sediment contamination levels are low enough to allow placement of excavated sediment on-site (and to be used for grassland habitat restoration).

Detailed design and planning efforts are currently underway, and may result in modifications to the information presented. Grassland restoration costs are included in the unit costs for wetland and wet meadows restoration. As noted previously, grassland restoration is an essential project component and would take place even in the absence of injuries that can be scaled to it, as it serves as a means for on-site, upland disposal of excavated sediments. Contouring and revegetation of such excavated sediments is standard practice. For these reasons, there is no additional cost associated with the grassland restoration project component.

Table 39. Summary of Project Costs: Mad Horse Creek Restoration.

Cost Element	Total Cost
Planning and Design	$315,586
Construction	$11,213,713
Monitoring	$628,640
Operations and Maintenance	$233,006
TOTAL*	**$12,390,945**

Notes:
This table represents costs for 25.4 acres of wetland, 35.0 acres of wet meadow and 100 acres of grassland habitat restoration. Grassland restoration costs are included in the unit costs for wetland and wet meadows restoration. Grassland restoration is an essential project component and would take place even in the absence of injuries that can be scaled to it, as it serves as a means for on-site, upland disposal of excavated sediments. Contouring and revegetation of such excavated sediments is standard practice.
* Total project costs do not include contingencies of 25% which are shown in Table 47.

Table 40 provides a summary of project costs for the pond and pasture project in New Castle County, Delaware. The costs include excavation of a 2.2-acre pond, planting and maintenance for 16 acres of pasture, and oversight of 23.6 acres of the agricultural lands. Maintenance costs

reflect semi-annual mowing of the pasture areas throughout the lifespan of the project, to ensure suitability to geese.

Table 40. Summary of Project Costs: Blackbird Reserve Wildlife Area Pond and Pasture Restoration.

Cost Element	Cost
Planning and Design	$3,744
Construction	$49,154
Monitoring	$3,651
Operations and Maintenance (50 years)	$48,342
TOTAL*	**$104,891**

Notes:

* Total project costs do not include contingencies of 25% which are shown in Table 47.

Tables 41 and 42 provide a summary of the costs for enhancing 73.5 acres of oyster reef.[50] For the Middle Seed bed project, two barge plantings of shell, initially in the seed beds and then transferred to the nursery beds, are included, with a total bed size of 49 acres over 3 years. For the Over the Bar bed, one barge planting of shell is included, with a total bed size of 24.5 acres.

[50] Written communication from Russell M. Babb, Jr., Principal Fisheries Biologist, New Jersey Division of Fish and Wildlife. 21 July 2006; Personal communication, Richard Cole, Delaware Department of Natural Resources and Environmental Control, Division of Fish and Wildlife.

Table 41. Summary of Project Costs: Creating a 49 acre oyster reef in "Middle Seed" bed area (N.J.).

Cost Element	Per Bushel	Per acre	Cost
Planning and Design			$32,987
Implementation			
Construction Oversight			$43,934
Planting at seed beds (1,500 bushels per final acre)			
Clam Shell	$0.85	$1,275	$62,475
Loading Fee	$0.10	$150	$7,350
Planting (Tug/Barge/Suction)	$1.25	$1,875	$91,875
Spat transplant (1,000 bushels recovered per 1,500 planted; planted at 1,000 bushels per acre)			
Re-harvest/Transplant	$1.50	$1,500	$73,500
		Subtotal	*$235,200*
Monitoring			$57,666
		TOTAL*	**$369,787**

* Total project costs do not include contingencies of 25% which are shown in Table 47.

Table 42. Summary of Project Costs: Creating a 24.5 acre oyster reef in "Over the Bar" beds (DE).

Cost Element	Per Bushel	Per acre	Cost
Planting at Over the Bar Beds (2,500 bushels per acre)			
Planning and Design			$26,565
Implementation			
Oyster Shell	$0.85	$2,125	$52,063
Planting	$2.75	$6,875	$168,438
Construction Oversight			$8,726
Monitoring			$38,235
		TOTAL*	**$294,026**

* Total project costs do not include contingencies of 25% which are shown in Table 47.

5.5.4 - Projects to Address Lost Recreational Uses

Trustee analysis indicates that the *Athos* oil spill had a direct adverse impact on recreational use of the Delaware River and its tributaries. Recreational losses occurred from the outset of the spill in November 2004 through October 2005, when recreational activity appeared to return to normal. An estimated 41,709 trips to the river were affected (*Athos*/Delaware River Lost Use TWG 2007), amounting to $1,319,097 in lost value (see Section 4.3.4).

Using the evaluation criteria described in Section 5.2, the Trustees are proposing three projects to restore recreational losses resulting from this spill. The Trustees have scaled these projects using a "value-to-cost" approach, such that the total value of recreational losses ($1,319,097) is approximately equal to the total cost of implementing the projects ($1,319,097).

The three projects preferred by the Trustees to restore lost recreational uses are described below.

5.5.4.1 - Stow Creek Boat Ramp

Project Description

This project would improve the Stow Creek boat ramp, a New Jersey-owned site located on the former Wosniak property in Stow Creek Township, Cumberland County, New Jersey (Figure 16). The existing ramp is extremely narrow and short, does not have a dock, and is in poor condition.

The boat ramp and surrounding 186-acre property is owned by NJDEP. The ramp, despite its poor condition, is heavily used for fishing, hunting, and ecological tours. The proposed improvements include widening and lengthening the ramp, removing the existing asphalt and replacing it with concrete, and constructing a small courtesy dock so that boats can be safely boarded, loaded, and unloaded. With proposed improvements, the boat ramp and dock would accommodate more hunters, fishermen, and ecological tourists. People using the facility would also be able to more safely launch their watercraft, and it would be more accessible for people with disabilities.

The proposed improvements would be constructed and managed by the State of New Jersey. The state would serve as the LIT for this project, with oversight by the Trustee Council.

Figure 16. Location of the Stow Creek boat ramp at the end of Stow Creek Road (marked by red star).

Restoration Objective

These boat ramp improvements would expand boating access to Stow Creek and the Delaware River and provide safer conditions for boaters. The Trustees believe the project would help facilitate recreational boating opportunities of the type lost during the spill.

Probability of Success

The Trustees believe that there is a high probability this project would provide increased opportunities for Stow Creek and Delaware River boating by enhancing the utility and safety of the current boat ramp facility.

Performance Measures and Monitoring

The performance measure for this project is completion of the boat ramp improvements and construction of a courtesy dock. State officials will maintain the site, though no further monitoring of the project is anticipated.

Approximate Project Costs

The total estimated project cost will exceed the amount allocated through this injury assessment. The Trustees have allocated a total of $197,600 for planning and design and $268,936 for construction activities. The remainder of the project costs will be funded by the State of New Jersey.

Table 43. Summary of Project Costs: Stow Creek Boat Ramp Improvements.

Cost Element	Cost
Planning and Design	$197,600
Construction	$268,936
TOTAL *	**$466,536**

Notes:

* Total costs for this project (including design and construction) amount to $809,688 and exceed the amount allocated through this injury assessment. Athos funding will cover the entire $197,600 design effort and $268,936 of the construction costs. The State of New Jersey will cover the remainder of the construction costs. Total project costs do not include contingencies of 15% which are shown in Table 47.

5.5.4.2 - Augustine Boat Ramp

Project Description

This project involves installing a rock jetty to the north of the Augustine boat ramp to prevent shoaling that is affecting the use and safety of this facility.

The existing boat ramp at Augustine Beach is located on the Delaware River in New Castle County, Delaware, about 1 mile south of Port Penn on Del. Route 9 (Figure 17). The site, owned and maintained by DNREC, includes two handicapped-accessible ramps, two courtesy docks and 100 parking spots, and is a popular site for boating, waterfowl hunting, and commercial and recreational fishing.

Figure 17. Location of the Augustine boat ramp, located in New Castle County, Delaware.

In 1987, a stone breakwater/jetty was constructed immediately south of the boat ramp to protect the existing ramp from excessive wave action. Following construction of the breakwater, shoaling was reported immediately in front of and offshore of the ramp. This shoaling has made boat launching and navigation through the area difficult and even impossible during certain tide conditions. This ramp is also an important emergency response location for local and state agencies responding to boating accidents, oil spills, and Homeland Security issues associated with the nearby nuclear power plant. As funds have permitted, DNREC has periodically dredged the area but this activity is becoming an annual event, and potential impacts associated with this dredging activity have become a concern.

The State of Delaware would serve as the LIT for this project, with oversight by the Trustee Council.

Restoration Objective

The objective of this project is to eliminate the existing shoaling problem at the Augustine site, by installing a rock jetty on the north side of the boat ramp thereby eliminating littoral transport of sediment into the channel associated with the ramp. This activity would enhance boat use and safety at this popular fishing, hunting, and boating launch area and increase access to the Delaware River.

Probability of Success

DNREC has completed a study modeling tidal circulation, sediment, and wind data to identify the source of shoaling and evaluate alternatives to reduce or eliminate the shoaling. The study concluded that the existence of a single breakwater is causing the shoaling, and recommended the installation of a northern breakwater over modifying or removing the existing breakwater as a long-term solution. Based on this information, the Trustees believe that installing an additional breakwater would reduce shoaling and that there is a high probability that this project would provide increased opportunities for Delaware River boating by enhancing the utility and safety of the current boat ramp facility.

Performance Measures and Monitoring

The performance measure for this project is completion of the installation of an additional rock jetty to meet design specifications. Local officials will maintain the site, though no further monitoring of the project is anticipated.

Approximate Project Costs

Based on the initial study, site visits, and consultations with coastal engineers, the total cost of the breakwater construction is estimated at $1,844,768. The exact cost would be based on the final project design currently being developed by DNREC.

The Trustees are allocating $818,687 for this project (Table 44). The State of Delaware has agreed to cover any additional costs above the $818,687 total. If this agreement is not fulfilled,

and sufficient funding for construction is not provided, the state would be responsible for all project costs incurred to that point (i.e., hydrodynamic and sediment transport analyses and final design costs) and the Trustees would initiate a public process to identify an appropriate alternative project. With the NPFC's concurrence, the $818,687 would then be applied to this new project.

Table 44. Summary of Project Costs: Augustine Boat Ramp Improvement.

Cost Element	Cost
Planning and Design	$102,330
Construction	$716,357
TOTAL	$818,687

Notes:
Total costs for this project are estimated at $1,844,768. The State of Delaware will supply the additional funds for this project.
* Total project costs do not include contingencies of 15% which are shown in Table 47.

5.5.4.3 - Little Tinicum Island Trail and Habitat Enhancement

Project Description

Little Tinicum Island is an approximately 200-acre island located on the Delaware River in Tinicum Township, Delaware County, Pennsylvania (Figure 18). Much of the island's shoreline was moderately to heavily oiled during the *Athos* incident.

Figure 18. Location of Little Tinicum Island on the Delaware River. The red star is the approximate site of the spill.

Little Tinicum Island is a designated Natural Area, owned by the Pennsylvania Bureau of Forestry. An estimated 3,500 to 4,000 people access Little Tinicum Island on a yearly basis (S. Insalaco, personal communication) but there are no maintained trails on the island. Instead, visitors cross the island on make-shift trails worn down by frequent use or struggle through the thick vegetation. Island visitors contribute to erosion by hiking on steep dredge spoil cell berms, disturbing rare mudflat habitat and plants, trampling ground-nests, and constructing illegal viewing/hunting blinds.

The preferred restoration project is to install a permanent trail, two observation decks, and a "breakaway bridge" to cross a small wet area. Figure 19 shows the location of the trail, which would be a loop on the berm of the large spoil cell with a feeder trail that would allow viewing of the existing inlet wetland and lead to a permanent duck blind. Along the trail, invasive plant species would be controlled and revegetated with native plants to prevent further spread of invasives by recreationalists using the trail. Figure 20 shows the location for the breakaway bridge and a proposed site for a wildlife observation deck.

The State of Pennsylvania would serve as the LIT for this project, with oversight by the Trustee Council.

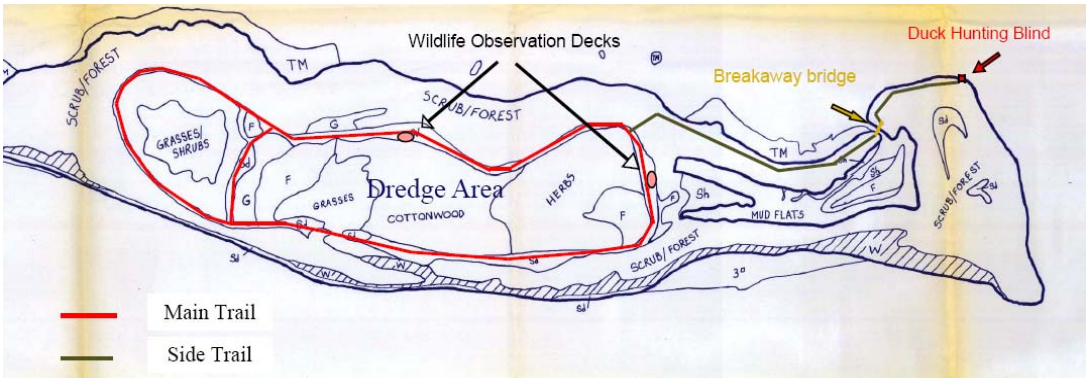


Figure 19. Little Tinicum Island Restoration site map showing location of the proposed trail (red line), breakaway bridge, and wildlife observation decks.

a. b.

Figure 20. Little Tinicum Island restoration site: a. Location for breakaway bridge; b. Location of one of two wildlife observation decks.

Restoration Objective

The Trustees believe this project would provide recreational opportunities similar to those lost during the spill, including shoreline activities such as wildlife viewing, hiking, fishing, and picnicking.

Probability of Success

Given the current use of the island with limited access, and its scenic nature, the Trustees believe this project would likely provide highly desirable and appropriate opportunities for increased shoreline use.

Performance Measures and Monitoring

The performance measure for this project is construction of the trail, observation decks, and breakaway bridge. State officials will maintain the site, though no further monitoring of the project is anticipated.

Approximate Project Costs

Estimated costs total $33,874 (Table 45). Major components of the costs include construction ($16,048) and operations and maintenance ($14,000).

Table 45. Summary of project costs: Little Tinicum Island Trail and Habitat Restoration.

Cost Element	Cost
Planning and Design	$3,826
Construction	$16,048
Operations and Maintenance	$14,000
TOTAL*	**$33,874**

Notes:
* Total project costs do not include contingencies of 15% which are shown in Table 47.

5.6 - Preferred Restoration Projects Summary

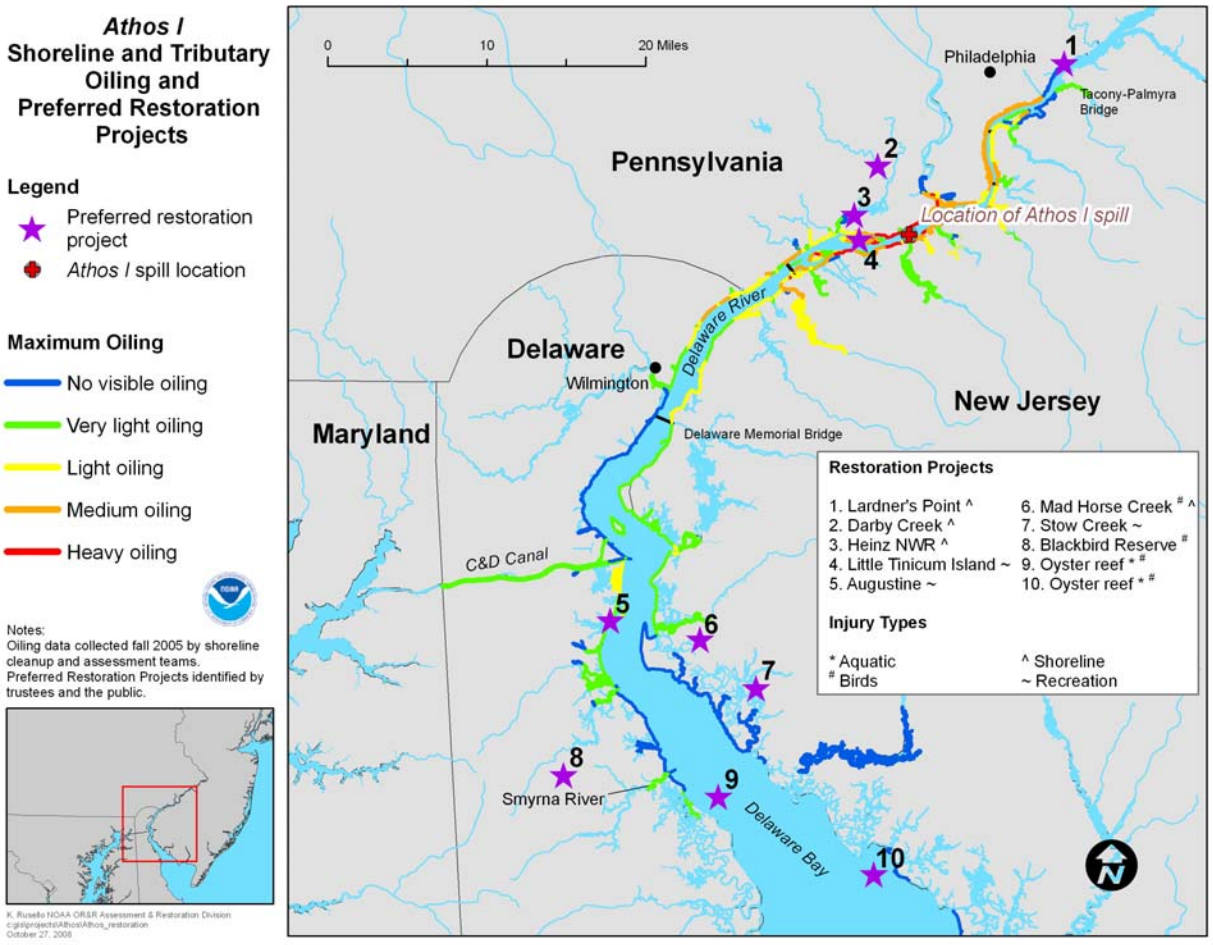
The preferred projects are based primarily on their benefit to the environment and their capacity to compensate the public for injuries to natural resources and services. The Trustees believe that the preferred projects in this restoration plan will not cause significant adverse impacts to natural resources or the services they provide.

Table 46 summarizes the preferred restoration projects and restoration costs for the *Athos* oil spill. As indicated below, costs to implement these projects total $26,474,470.

Table 46. Summary of injuries resulting from the *Athos* incident and preferred restoration projects.

Resource Category		Preferred Compensatory Restoration Projects		Project Cost
Aquatic	Subtidal benthic habitat	4.5 acres	Oyster reef enhancement and restoration (Del. and N.J.)	$703,490
Bird and Wildlife	Gulls, diving ducks, diving birds, wading birds, kingfishers	73.5 acres		
	Dabbling ducks	25.4 acres	Mad Horse Creek (N.J.) marsh restoration	$12,390,945
	Swans and geese	35 acres	Mad Horse Creek (N.J.) wet meadow	
		100 acres	Mad Horse Creek (N.J.) grassland restoration	
		41.8 acres	Blackbird Reserve (Del.) pond and pasture enhancement	$104,891
Shoreline	Seawalls, sand/mud substrate, marsh, coarse substrate	34.2 acres	Mad Horse Creek (N.J.) marsh restoration	$7,016,065
		0.9 acre	Lardner's Point (Pa.) shoreline restoration	$643,271
	Tributaries	56 acres	John Heinz habitat restoration	$2,968,517
		2.6 miles	Darby Creek (Pa.) dam removal and habitat restoration	$1,328,194
Recreation	Trips affected (lost and diminished value)	$466,536	Stow Creek (N.J.) boat ramp improvements	$1,319,097
		$818,687	Augustine boat ramp stone jetty installation	
		$33,874	Little Tinicum Island trail and habitat improvements	

The location of preferred restoration projects are shown in the figure below (identical to Figure 8).



5.7 - Restoration Contingency Costs

As explained in section 5.1, a contingency factor of 25 percent is included for each of the ecological restoration projects to account for the uncertainties inherent in these preliminary estimates and to cover the risk that the costs of the projects would turn out to be higher than expected, and/or the projects would not result in the expected magnitude of benefits and need augmentation. These contingency costs are presented in Table 47 as a separate category of restoration costs, rather than included in the tables of costs for restoration itself, since they represent expenditures that might not occur.

Table 47. Contingency Costs per Project, based on 25 percent of the total project cost for restoration projects and 15 percent of the total cost for recreational projects.

Project	Contingency
52 acre oyster reef in "Middle Seed" bed area (NJ)	$97,818
26 acre oyster reef in "Over the Bar" beds (Del.)	$78,055
Mad Horse Creek restoration	$4,851,753
Blackbird Reserve	$26,223
Lardner's Point shoreline restoration	$160,818
Darby Creek dam removal and habitat restoration	$332,049
John Heinz habitat restoration	$742,129
Little Tinicum Island Trail and Habitat Restoration	$5,081
Stow Creek Boat Ramp	$69,980
Augustine Boat Ramp	$122,803

5.8 - Trustee Council Oversight Costs

A Trustee Council, consisting of representatives from the trustee entities, will oversee implementation of each restoration project. The Council will be responsible for all aspects of project implementation, including statements of work, selection of contractors, final designs/plans and work plans, monitoring, ensuring that final projects compensate for losses as scaled, and certifying the completion of each project. NOAA will serve as the lead administrative trustee, with additional responsibilities for the day-to-day administrative affairs of the Council that include: establishing and maintaining a Record for restoration implementation that, at a minimum, includes all restoration implementation decisions and expenditures; disseminating information about each project though the project website; facilitating regular Trustee Council meetings and communication; tracking expenditures for each restoration project; and providing quarterly reports to the NPFC. Table 48 summarizes Trustee oversight costs.

Table 48. Summary of Trustee Council oversight costs.

Trustee	Total Hours	Total Cost Year 1	Total Cost Year 2	Total Cost Year 3	Total Cost Year 4	Total Cost Year 5	Total Cost Year 6	Total Cost Year 7	Total Cost All Years
NJDEP	2408	$6,442.40	$6,635.67	$6,834.74	$7,039.78	$7,250.98	$7,468.51	$7,692.56	$49,364.64
DNREC	728	$4,856.00	$5,001.68	$5,151.73	$5,306.28	$5,465.47	$5,629.43	$5,798.32	$37,208.91
USFWS	1960	$9,121.20	$9,394.84	$9,676.68	$9,966.98	$10,265.99	$10,573.97	$10,891.19	$69,890.85
Pennsylvania	1568	$5,155.76	$5,310.43	$5,469.75	$5,633.84	$5,802.85	$5,976.94	$6,156.25	$39,505.82
NOAA	5672*	$110,976.80	$114,306.10	$117,735.29	$121,267.35	$124,905.37	$128,652.53	$166,810.35	$884,653.79
	Subtotal	$136,552.16	$140,648.72	$144,868.19	$149,214.23	$153,690.66	$158,301.38	$197,348.67	
	25% Contingency	$34,138.04	$35,162.18	$36,217.05	$37,303.56	$38,422.67	$39,575.35	$49,337.17	
	TOTAL	**$170,690.20**	**$175,810.90**	**$181,085.24**	**$186,517.79**	**$192,113.33**	**$197,876.73**	**$246,685.84**	

*These hours do not include the time that will be needed for case closure in the final year.

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Appendix 1. Athos Trustee Responses to Public Comments

Athos: Trustee Response to Comments

Introduction: On January 6, 2009, the *Athos* Trustees published the draft Damage Assessment and Restoration Plan/Environmental Assessment (draft DARP/EA) for public comment. The draft DARP/EA solicited input from the public and other interested parties concerning the damage assessment and restoration required to address the 2004 *Athos* oil spill in the Delaware River and tributaries, which affected natural resources of Delaware, Pennsylvania, New Jersey, and the United States, which are held in trust on behalf of the public. The draft DARP/EA was the culmination of the federal and state Trustees' assessment of natural resource injuries and lost services resulting from the *M/T Athos I* (*Athos*) incident. After assessing those injuries and losses, the Trustees carried out an exhaustive search for potential actions that would restore, replace, rehabilitate, or acquire the equivalent of the injured natural resources and lost services.

Comments on the draft DARP/EA, which can be found at: http://www.darrp.noaa.gov/northeast/athos/index.html, were received from:

- Four members of the general public;
- Congresswoman Allyson Schwartz;
- Fairmount Park;
- Delaware County (PA) Planning Department;
- Delaware County (PA) Conservation District;
- American Rivers;
- Borough of Lansdowne (PA);
- Delaware Riverkeeper Network;
- American Bird Conservancy ;
- International Tanker Owners Pollution Federation Limited (ITOPF);
- CITGO Petroleum Corporation;
- ENTRIX, Inc;
- Frescati Shipping Company Ltd. and Tsakos Shipping & Trading, S.A.; and
- Evergreen Environmental, LLC

The comments represented diverse opinions and demonstrated a wide-spread interest in and around the area of the incident. This document summarizes the comments, by areas of interest, and gives the Trustees' analysis of and response to each comment. The Trustees appreciate the effort that went into the comments received, and carefully considered these comments in completing the final Restoration Plan.

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Athos Oil Spill Incident and Preassessment

Comment 1: One commenter questioned whether intakes at the Salem Nuclear Power Plant were contaminated or if there was only fear of contamination.
Response: The Salem Nuclear Power Plant made the decision to conduct a controlled precautionary shut down (USCG 2005). The draft DARP/EA had initially outlined the decision made by the power plant. But, after consideration of the public comments, the Trustees agreed that the language cited in the DARP about this issue is outside the scope

of the NRDA and the Trustees' decision-making, and so has been removed from the final document.

Comment 2: One commenter questioned why the DARP contained references to oiling at marinas since vessels and facilities were cleaned during response, and damage claims for private property are a private, third party matter.
Response: The Trustees agree and the referenced language has been removed from the final Restoration Plan.

Comment 3: One commenter noted that the liability limit for *Athos* was different than indicated in the DARP.
Response: The Trustees agree and have made relevant corrections in the final Plan.

Comment 4: One commenter stated that the polluter should pay $50 million dollars to the NJ Treasury as a message to be sent to polluters that it is time to shift to double hulled ships.
Response: This comment is outside the scope of the natural resource damage assessment.

Comment 5: One commenter stated that the Trustees made no attempt to engage the Responsible Party (RP).
Response: The Trustees provided the RP with significant opportunities for involvement in the NRD process, in accordance with the coordination requirements set forth in the natural resource damage assessment (NRDA) regulations (15 CFR 990) for the Oil Pollution Act of 1990 (OPA), 33 U.S.C. § 2700 *et. seq.* These regulations require the Trustees to invite the RP, in writing, to participate in the NRDA. (*See*, 15 C.F.R. § 990.14). NOAA sent this invitational letter to the RP on March 9, 2005. NOAA followed up this invitation with further RP correspondence, outlining the NRDA process and its requirements. NOAA repeatedly engaged the RP during the assessment process. RP representatives participated in several meetings with the Trustees to discuss case-related issues and data, and exchanged technical comments. For example, on June 20, 2006, NOAA provided detailed responses to RP comments to NOAA's draft Bird and Wildlife Injury Assessment. NOAA developed a similar response to RP comments to its draft Aquatic Injury Assessment report, and to its draft Shoreline Injury Assessment report on January 27, 2006. These Reports outlined the Trustees' logic used to assess the ecological impacts of the *Athos* spill. NOAA's responses to the RP's comments contained lengthy explanations on the development of injury data and the assumptions used by the Trustees when addressing environmental losses. Likewise, on October 10, 2006, April 17, 2007, and May 9, 2007, the Trustees provided the RP with detailed responses to comments on the Trustees' Lost Use Valuation Report. This document outlined the approaches used by the Trustees to place a value on public and recreational losses. All of these referenced Reports informed the Trustees while they developed their proposed restoration projects. Copies of the correspondence and Reports referenced above can be found on NOAA's website at: http://www.darrp.noaa.gov/northeast/athos/admin.html

Comment 6: One commenter noted that the draft DARP/EA did not mention the role of the RP in response efforts, or that the RP agreed to pay $100,000 to begin the NRDA process.
Response: Since the NRDA process focuses on restoration planning, the draft DARP/EA has only a brief summary of the response efforts to provide background to the NRDA. The United States Coast Guard (USCG), as the lead on the *Athos* response, is the agency that documents the extensive role of the RP in the emergency response, not the Trustees. The final Restoration Plan notes the RP funded parts of the early injury assessments.

Comment 7: One commenter asked several questions on the results of the sediment contaminant study conducted in September 2005. These questions included the number of samples used for fingerprinting analysis, the locations of these samples throughout the river, and the percentage of overall samples that were analyzed using a fingerprinting method.
Response: The Trustees led collection of 162 sediment samples, with assistance from consultants for the RP, from throughout the potentially affected zone. Screening level analysis was conducted on all 162 samples and 20 samples were selected for laboratory polycyclic aromatic hydrocarbon (PAH) analysis. The RP reviewed the data from full PAH analysis conducted on those 20 samples and performed their fingerprinting assessment. The locations of the 162 samples were throughout the spill zone. The exact locations are noted in the Aquatic Injury Assessment report, available in the Administrative Record for this incident (http://www.darrp.noaa.gov/northeast/athos/admin.html). Of the 20 samples selected for further analysis, eight were in subtidal areas adjacent to the shorelines denoted as heavily oiled. These eight samples were located at Tinicum Island or further upriver; the remaining 12 were at the western end of Tinicum Island or further downriver.

Comment 8: One commenter objected to a statement in the DARP on the source oil. The commenter asserted that the document implied that 99.5% of the oil sank to the sea bed and killed all benthic organisms and that this statement could be misconstrued.
Response: The Trustees believe the indicated statement is appropriate and have retained it in the final Restoration Plan

Comment 9: One commenter asked if the amount of stranded oil in the two trenches at the collision site was an estimate or a verified quantitative amount.
Response: The numbers referenced in the DARP were estimates, based on diver survey projections of oil thickness in the trenches and trench dimensions. The Final Preassessment Data Report (June 2006) reported that pooled stranded oil was found only at the collision site, in a trench 6 to 8 feet wide, 2 feet deep, and 41 feet long. On December 9, 2004, a diver surveyed the trench area and measured the oil thickness as between one and a half and two feet deep. A second trench was also detected and estimated to be two feet wide by two feet deep by 15 feet long.

Comment 10: One commenter stated that the maps detailing level of shoreline oiling were not detailed enough and had poor use of color, such that impact may be overstated. The commenter suggested that use of more distinctive colors and a map showing natural versus man-made shorelines would have shown impacts more appropriately. The DARP

also stated that 280 miles of shoreline had been exposed to oil. The commenter felt that this statement, along with the map, did not convey the information found in Table 2 of detailed oiling categories.
Response: The figure referred to is a standard Shoreline Cleanup Assessment Team (SCAT) oiling map produced during the response and shows oiled areas as observed in the field. According to SCAT data, approximately 280 miles were exposed to *Athos* oil. Maps detailing shoreline type are not commonly produced for spills. The Trustees believe that the oiling map included in the draft DARP/EA provides useful, visual depictions of the extent and nature of oil distribution, but it is the data in the map, not the map itself, that informed the Trustees' decisions.

Comment 11: One commenter stated that the following information should have been included in the DARP: detail on the *Athos* tanker itself (single hull description); timing of the incident; the decisions of the operators and owners; and specific information in the USCG report "Investigation into the Striking of Submerged Objects by the Tank Vessel *Athos I* in the Delaware River on November 26, 2004, with a Major Discharge of Oil".
Response: The USCG report outlining this information is included in the Administrative Record. Because the NRDA process focuses on restoration planning, this information is not included in the draft DARP/EA, nor the final RP/EA.

Comment 12: One commenter stated that the draft DARP/EA should include the amount of estimated oil remaining in the Delaware River after clean up.
Response: Available information is insufficient to reliably estimate the amount of oil remaining in the environment after cleanup due to substantial uncertainties in the oil content of oily debris and oily liquid recovered during cleanup.

Comment 13: One commenter stated that there was discrepancy in the DARP's references to the amount of injured acres and the amount of acreage proposed for restoration. The commenter noted that a more comprehensive and widespread clean up is necessary in response to the *Athos* tanker spill.
Response: The emergency response to address the *Athos* spill was conducted by the U.S. Coast Guard and is outside the scope of this damage assessment and restoration plan. Compensation for injuries does not occur on a one-to-one scale due to differences in the severity, duration, and timing of injury compared to the magnitude, duration, and timing of restoration benefits. Although acreage is an important variable in injury and restoration scaling, the scaling process focuses on restoring lost recreational and ecological services, which will likely differ depending on the specifics of the habitat or site under consideration. Consequently, one acre of restoration at one location might not provide the same level of services as one acre injured at a different location.

Comment 14: One commenter asked if there are new technologies being developed to assist in response and if so, how they are being incorporated into response to future spills.
Response: This issue is outside the scope of the natural resource damage assessment, and is better addressed by the U.S. Coast Guard and the U.S. Environmental Protection Agency.

Comment 15: One commenter asked who had comments regarding background contamination of the region.
Response: Please refer to the online Administrative Record (found at: http://www.darrp.noaa.gov/northeast/athos/admin.html) for copies of comments submitted with respect to the draft DARP/EA.

Comment 16: One commenter noted that areas like Woodbury Creek appeared to have high levels of PAHs in the sediment.
Response: The Trustees note this comment. Of the subtidal samples collected during the pre-assessment phase, Woodbury Creek had the highest levels. This location is included in the injury assessment.

Injury Determination

General

Comment 17: One commenter questioned the degree of consensus between the Trustees and the Responsible Party (RP) with regards to the injury assessments as evidenced by comments and responses to comments on various documents in the Administrative Record.
Response: With numerous parties involved in the *Athos* damage assessment and restoration process, the best solution to assess and restore injured natural resources and services was employed. The Trustees made sure to fully consider all input and to seek consensus where possible. Where consensus was not possible among the RP and Trustees, the Trustees had the ultimate responsibility to make final decisions.

Comment 18: Two commenters noted that a dollar amount was assigned in the DARP to recreational resources affected by the spill, but that there was no corresponding dollar estimate for the ecological resources injured.
Response: Different approaches are typically used to scale ecological versus recreational service losses. The ecological projects selected in the draft DARP/EA were scaled using a service-to-service approach, also authorized by OPA and preferred for this type of loss, such that required compensation is equal to the cost of restoration projects sufficient to restore the ecological service lost due to the spill. Ecological service losses (and gains) are typically denominated in discounted service-acre years (DSAYs), which represent ecological services lost (or gained) over time. Using Habitat Equivalency Analysis, a service-to-service approach, the DSAYs provided by each restoration project are determined; the suite of projects is selected so that the DSAYs gained from the projects match the DSAYs lost from the injury. This approach ensures full compensation to the public for the injury.

Recreational scaling in the draft DARP/EA used a dollar-based rather than DSAY-based approach. The recreational projects were scaled using the value-to-cost approach

authorized by OPA, under which an amount of money equal to the value of recreational services lost due to the spill will be spent on projects to enhance recreational services.

Comment 19: One commenter expressed concern with involving the RP in the Trustees' assessment process. The commenter asked what provisions are in place to ensure that the RP does not unfairly hold up the process, thereby delaying, to some extent, restoration implementation. The commenter expressed concern that the environment may not be made whole through a cooperative assessment with the RP, in that the RP may have swayed the findings. Finally, the commenter stated that the public should be given equal opportunity to participate in discussions and negotiations. This same commenter wanted to review the discussions between the Trustees and the RP and to know how the decisions were changed or modified based upon the RP input.
Response: OPA's NRDA regulations on coordination require that the Trustees invite the RP to participate in DARP development, while ensuring that Trustee/RP correspondence is placed in the Administrative Record. The Trustees have done this (for copies of this communication, *see*, http://www.darrp.noaa.gov/northeast/athos/admin.html). Likewise, the Trustees ensured that its draft DARP/EA outlined the nature and extent of the RP's participation and described why the RP's participation was terminated, in accordance with OPA's implementing regulations (*See*, 15 C.F.R. § 990.14; draft DARP/EA § 2.1.1.2; and throughout Chapter 4 – Injury Determination).

The Commenter's question also focuses on the role of the RP when responding to an oil spill and addressing injuries caused by that spill. Although the OPA's implementing regulations on NRDA encourage the RP's cooperation when developing and implementing assessment plans, the RP is, in fact, a potential defendant under OPA. Specifically, the RP is liable for natural resource damages (*See*, 33 U.S.C. § 2702). Accordingly, the role of the RP in the damage assessment process is distinct from that of the public or a Trustee acting on behalf of the public. RP involvement in the NRDA process can allow for an amicable settlement of natural resource damage claims. Therefore, while the participation of the RP and members of the public is not identical, it is equitable, given the RP's status as potential defendants and the Trustees' actions on behalf of the public.

The Commenter, and others, may review the interactions between the RP and Trustees in the Administrative Record (available at: http://www.darrp.noaa.gov/northeast/athos/admin.html) to consider RP comments on injury assessments relating to the *Athos* spill, as well as the Trustee responses.

Comment 20: One commenter noted that the RP was excluded from the peer review of the injury assessment reports. This commenter stated that the Trustees chose the reviewers without consulting with the RP, an omission that was inconsistent with a letter from the RP offering assistance on June 21, 2005 (*See*, http://www.darrp.noaa.gov/northeast/athos/pdf/Sharon_Shutler_letter_dated_06.21.05.pdf). The commenter also stated that such actions by the Trustees were inconsistent with a Memorandum of Understanding (MOU) with the International Group of Protection and Indemnity Clubs (P&I Clubs) (*See*,

http://www.darrp.noaa.gov/northeast/athos/pdf/NOAA_P&I_Club_MOU_signed_10_16_07.pdf). The commenter noted that, pursuant to that MOU, the Trustees should have involved the P&I Clubs' technical consultants, the International Tanker Owner Pollution Federation (ITOPF) in the peer review process, as well as in the broader role of mediation of any technical differences in the assessment. Finally, this commenter requested that all peer reviewer communications, including any discussions of potential conflicts of interest, be placed in the Administrative Record, since one of the reviewers has on-going research initiatives within some of the areas affected, or potentially affected, by the incident.

Response: On the issue of whether the Trustees' choice of scientific reviewers was inconsistent with terms laid out in a Trustee letter, dated June 21, 2005: In 2005, the RP declined to underwrite the Trustees' costs associated with the NRDA and NRDA pre-assessment activities because the RP had already exceeded its limit of liability. Instead, the RP offered to fund the cost of studies undertaken by their own contractors, which the RP would hire directly. The RP also offered to provide their own experts for the Trustees' use. Both offers were conditional, i.e., funding for these studies/experts was conditional upon the RP's decision to submit a claim and the National Pollution Funds Center's (NPFC) response (*See*, RP letter May 24, 2005, p. 2-3). In their response the Trustees encouraged the RP involvement with assessments, with the understanding that the Trustees reserved the right to meet only among themselves. Further, because the RP asserted it would not pay more than an initial $100,000 provided, the Trustees believed that it was not appropriate to convene a Joint Assessment Team with the RP. Finally, though the Trustees did not decline the RP's offer to finance its own scientific studies or to use industry experts, they stated that such collaboration would only occur with Trustee agreement with industry hiring decisions, study objectives, and scopes of work. The terms laid out in this June 21, 2005, letter are consistent with Trustee actions (*See*, http://www.darrp.noaa.gov/northeast/athos/admin.html).

On the issue of whether Trustee actions were inconsistent with a Memorandum of Understanding (MOU) with the International Group of Protection and Indemnity Clubs (P&I Clubs) and involving the International Tanker Owners Pollution Federated (ITOPF, the technical experts for the P&I Clubs)), the MOU at issue was signed by NOAA and the P&I Clubs. Under this MOA, these parties agreed to coordinate to identify a responsible party quickly after an oil spill has occurred and to allow for ITOPF's provision of technical information, if needed. While this MOU provides for a cooperative relationship between NOAA and industry when responding to oil spills, NOAA is currently the only Trustee who has signed the MOU. In contrast, the *Athos* oil spill site involved multiple Trustees, including the states of Delaware and New Jersey, the Commonwealth of Pennsylvania, and the U.S Fish and Wildlife Service, as well as NOAA. Each of these Trustees are accorded the same level of authority and deference when addressing issues of how to address the *Athos* oil spill, the development of scientific studies, and the process of drafting the NRDA documents. Accordingly, the Trustees consulted with the representatives of the NPFC, which would receive the Trustees' request for NRDA expenses. These NPFC representatives assisted the Trustees in selecting scientific peer reviewers to consider the injury assessment reports. All peer reviewers are highly qualified, and free from conflicts of interest. It should be noted the

RP reviewed each of the Trustees' injury reports before they were finalized. The RP was free to engage whatever peer reviewers it chose. All RP comments were shared with the peer reviewers and placed in the Administrative Record.

Comment 21: One commenter stated that any dredging of horseshoe crabs should be done with a scallop dredge rather than a tooth-bar dredge to limit injury to crabs and whelk during surveying.
Response: This comment is noted.

Baseline

Comment 22: One commenter notes that OPA requires potential spill impacts and restoration activities are evaluated relative to baseline conditions, and that the spill area in this case was largely an industrialized portion of the Delaware River adjacent to Philadelphia. This area is subject to urban runoff, combined sewer overflows, and analysis suggests that approximately 90% of the PAHs found in sediments 10 months after the spill were present prior to the incident. The commenter asserts that *Athos* methods and assumptions are taken directly from the Chalk Point oil spill assessment, without any adjustment for the vastly different baseline conditions. The commenter notes that at Chalk Point the affected marsh was a high quality marsh with little background PAH, few impacts from urbanization, and limited *Phragmites.* Using that high quality marsh as baseline, the Trustees asserted that restored and created marsh sites will provide services equivalent to 80% of the high quality marsh. It appears inconsistent for the *Athos* DARP to similarly assert that habitat restoration will achieve 80% of baseline, but in this case 80% is a very low quality baseline. The commenter asserts that either these are very poor projects, or the Trustees' do not properly account for baseline in the injury assessment.
Response: As stated in the Trustees' Aquatic Injury Assessment for the *Athos* spill, in 1997 NOAA completed a broad triad study throughout the Delaware River and Bay to examine the spatial extent and severity of sediment toxicity (Hartwell *et al*. 2001). Toxicity tests and benthic invertebrate population studies were conducted at 81 sites from the Delaware River at Trenton, NJ, to the mouth of the Delaware Bay and adjacent open ocean. Seventeen sites, described as the "mid-river region" are located in the mainstem of the river in the areas closest to the incident.[51] Average control-adjusted survival of amphipods (*Ampelisca abdita*) was 90.1 percent in 10-day mortality tests using sediments from these sites. These data suggest that amphipod populations were slightly depressed (i.e., by 10 percent) in the study area prior to the *Athos* spill. Amphipods are a good indicator species because they were often found in Delaware River sediment samples taken as part of the 1997 NOAA study and are known to be sensitive to contamination. Based on these data, the Trustees made the reasonable, simplifying assumption that a 10 percent reduction in benthic service levels is associated with baseline conditions (i.e., conditions that would have existed in the absence of the spill). Because tidal flats were

[51] Eighteen sites are included in the mid-river region. However, the chemistry at one site is marked by the authors as suspect, and so the site is dropped from the current analysis.

the dominant shoreline habitat injured by the spill, and in the absence of tidal flat-specific data on baseline conditions in the spill-affected area, the Trustees apply this same baseline service level (90 percent) to shoreline habitat injury calculations and revise associated loss estimates accordingly in the final RP/EA.

Aquatic resources

Comment 23: One commenter raised several issues regarding the subtidal injury determination presented in the draft DARP. Particular issues noted were the results of PAH analyses, the differentiation of oiling from background levels (fingerprinting), calculations of service losses (both baseline and due to the oiling), and calculation of injury area. The commenter also notes various qualitative descriptions of aquatic oiling and sunken or subsurface oiling, and questions their relationship to the subtidal injury assessment.
Response: Methods for quantifying injury (including the use of contaminant thresholds and sediment toxicity test results), comparisons to thresholds, and evaluation of fingerprinting and background levels of contamination for subtidal sediments are all discussed in the Aquatic Injury Assessment report, available in the Administrative Record for this case (http://www.darrp.noaa.gov/northeast/athos/admin.html). A weight-of-evidence approach is described in that document for the subtidal injury assessment. Subsurface (suspended) oil was not considered to be a significant driver of injury to water-column resources and the Trustees did not include it in the injury assessment.

Comment 24: One commenter noted that the *Athos* oil contained only a small percentage of PAHs as part of its overall chemical composition, that only a small fraction of those PAHs present would potentially have ended up in subtidal areas, and that only the soluble fraction of those PAHs present would cause toxicity. The commenter noted that the RP's fingerprinting analysis indicates that, of the September 2005 samples, only as much as 10 percent of the PAH signature could be *Athos* oil. The commenter further stated that the Trustee assessment of initial injury to subtidal areas would require a mass-loading of PAHs greater than that present in the entire volume of oil spilled. Additionally, the toxicity testing from Tinicum Island is rejected as not representative of conditions in the area.
Response: The September 2005 samples referenced in the comment were taken approximately 10 months after the spill. As described in the DARP, Trustee estimates of longer-term injury to subtidal habitat (10 months post-spill and beyond) are consistent with a modest contribution of *Athos* oil relative to existing background levels of contamination (i.e., estimated 10% *Athos*-caused service loss 10 months after the spill, decreasing to no (0%) service loss 14 months after the spill). Further, in contrast to the comment's implication, PAH-related toxicity was not assumed to be the sole mechanism of injury, either for subtidal or shoreline injuries. Trustee injury analyses incorporate potential impacts arising from multiple exposure pathways, including physical effects as well as toxicity arising from PAHs and potentially other components of the spilled oil. Mass balance calculations for the *Athos* spill, such as those presented in the comment, are subject to a high degree of uncertainty and are not suitable for consideration of potential

physical effects of spilled oil. The Trustees use all available data in their analyses, including spill-specific toxicity testing data. Multiple lines of evidence confirm the presence of oiled subtidal sediments attributable to the spill and support the estimates of aquatic injury presented in the DARP.

Comment 25: One commenter stated that the sediment contamination from a toxicity test collected adjacent to the spill one and three months post-spill has not been determined. The commenter also stated that it is not clear from the DARP how the data was extrapolated to 412 acres.
Response: Toxicity testing conducted on sediment samples taken approximately one month and three months after the incident from a heavily oiled location near Tinicum Island found statistically significant differences from control samples, while testing from two other subtidal sediment locations with much less exposure to spilled oil did not. While the available toxicity data are limited in number and location, the tests add to the weight of evidence indicating likely injury in the areas near heavily oiled shorelines. Injury "polygons" were delineated from the waterward edge of the intertidal zone to the 18' depth contour in areas adjacent to heavily oiled shoreline locations. The result of this analysis indicated that 412 acres of subtidal areas were in the designated “likely injury” area adjacent to heavily oiled shorelines. Further details on the analysis are provided in Section 3.2 (Spatial Extent of Injury) and Section 3.3 (Service Loss and Recovery) of the Aquatic Injury Assessment report.

Comment 26: One commenter expressed comments and questions on the methodology used by the Trustees in the subtidal injury assessment. In particular, the commenter is concerned about the observations and measurements used for identifying extent of contamination (degree and extent) and for identifying baseline service loss.
Response: The areas delineated for subtidal impacts were not designated as 100% injured from an ecological services point of view, but rather were assigned injury levels based on toxicity testing results. Given that initial investigations concluded that subtidal impacts, while likely, were limited in scope, a thorough sediment investigation of the entire potentially impacted area would not be cost-effective. The Trustees chose to use a weight-of-evidence approach that combined the limited analytical chemistry data with observational data (shoreline and V-SORS oiling) and toxicity test results. The baseline service loss (injury occurring due to other factors) for the affected section of the Delaware River was identified based on matched sediment toxicity and sediment chemistry data from a pre-spill ecological study conducted in the Delaware River and Bay. For additional details on the methodology of the injury assessment, please see the Aquatic Injury Assessment report, available in the administrative record for this case (http://www.darrp.noaa.gov/northeast/athos/admin.html).

Comment 27: One commenter wondered whether dead fish counts were compared to background levels or if the fish were determined to have died from *Athos* oil. The commenter was concerned that these observations do not help in determining whether there was injury to aquatic resources.
Response: Twenty-five dead fish were found during oiled shoreline surveys, but available information was insufficient to determine if the fish died because of oiling or

died prior to the spill and were then oiled. A baseline number of dead fish that might be expected to be found during routine shoreline surveys is also not available. Therefore, fish were not included in the aquatic injury calculations.

Bird Resources

Comment 28: One commenter entered the following statement regarding modeling of wildlife injury when a concurrent restriction on hunting occurred due to the incident causing the injury:

> The principle of estimating "net changes" is embedded in the Department of the Interior's "CERCLA Type A Natural Resource Damage Assessment Model for Coastal and Marine Environments (NRDAM/CME)." In describing total injury for a spill that involves both direct mortality due to oiling and a recreational closure the authors note:
>
> > *Some of Y_{CL} [lost harvest due to closure] would be lost due to mortality regardless of closure. As a result, only that portion of losses due to a closure that exceed losses from mortality is added to total losses (French et al. 1996, page I.4-54; emphasis added).*
>
> That is, when estimating total spill-related injury it is necessary to consider the interaction between the effect of oiling/oil ingestion on a resource and the effect of any spill-related area closure.

Response: The commenter incorrectly interprets the lost harvest method within the NRDA Type A model. The lost harvest equation is stated more clearly on p. 1.4-58 of French et al. 1996: "The total lost harvest is the lost harvest due to direct or indirect mortality *plus* those not killed but not hunted due to area closures" (emphasis added). Additionally, this section of the Type A model is only relevant in cases where the Trustees use lost harvest as a method of assessing recreational injury. For the *Athos* injury assessment, the Trustees evaluated lost, degraded, and substitute hunting trips to assess recreational injury. The potential interaction between affected hunting trips and estimates of ecological loss is addressed in a separate response.

Comment 29: One commenter questioned how the multiplier for dead birds was determined. The commenter also questioned the likelihood that studies used to base the "direct loss" calculation on were the same conditions and involved the same species as the *Athos* incident, i.e., how did the Trustees use and extrapolate figures from past studies to give a dead bird count?

Response: Rather than a multiplier approach, data from ground and aerial surveys were used in a risk-based assessment to determine the full extent of bird and wildlife losses resulting from the *Athos* incident. In general, the total number of non-recovered birds present in the area was estimated from detectability-adjusted aerial survey data for each of nine guilds or species in three time periods. The number of birds in different oiling categories for each of these same guilds and time periods was estimated from ground

survey data. This oiling information, with mortality rates derived from the literature and expert opinion, was then used to estimate the number of non-recovered birds that were oiled and died in the field, or that survived with potentially sublethal impacts. These estimates, combined with data on recovered birds from the wildlife rescue effort, were used to determine the total number of birds impacted. Please see Sections 4 through 6 of the Bird and Wildlife Injury Assessment report for a detailed description of the methodology used to estimate direct injury. Table 9 in Section 6.3 includes the results of these analyses.

Comment 30: One commenter asked how many future generations were included in the estimation of total bird injury.
Response Indirect injury in terms of production forgone due to the loss of future generations was composed of two parts: (1) the discounted loss of production from dead individuals, projected for one generation either 7 or 9 years from the time of the spill based on one-third of life expectancy, and (2) the discounted loss of production due to individuals that were oiled and survived, but failed to breed in the subsequent spring, calculated for one additional generation. Please see Section 7 of the Bird and Wildlife Injury Assessment report for a detailed description of the methodology used to calculate indirect injury. Table 11 in Section 7.3 includes the results of these calculations.

Comment 31: One commenter stated that the Trustees assume lost biomass associated with the offspring of oiled birds, leading to infinite injury, which they handle by limiting calculations to include one generation forgone. The commenter then stated that analysis should not use a model based on infinite debit, but rather an ecologically-based model incorporating biological data and effects of restoration. The commenter requested that Trustees conduct a resource equivalency analysis (REA) using ecologically grounded models to estimate baseline with spill and restoration population projections. If the Trustees do not conduct the REA, the commenter requested that Trustees amend the administrative record by adding: (1) A description of assumed biologically limiting factors; (2) A description of literature relied upon; and (3) A description of how the selected assumption regarding biologically limiting factors and population demographics were mapped into assumptions regarding forgone generations.
Response: The Trustees have given consideration to the issue of biological recovery mechanisms, including density dependence, but the influence of such mechanisms on the population dynamics of even the most well-studied species is uncertain and changes from year-to-year. Furthermore, the lumping of the greater than 80 separate injured bird species into biological guilds for estimating injury prevents the adoption of assumptions about species-specific population trends and limiting factors in assessment of biological recovery. Information required to quantitatively evaluate the impact of all potential biological recovery mechanisms separately, for each species injured, was not available.

In an effort to address the uncertainty surrounding the presence of such mechanisms and the relative importance of the population dynamics of so many species, the Trustees conservatively calculated indirect injury as: (1) the discounted loss of production from dead individuals, projected for one generation either 7 or 9 years from the time of the spill based on one-third of life expectancy, and (2) the discounted loss of production due

to individuals that were oiled and survived, but failed to breed in the subsequent spring, calculated for one additional generation. As such, the Trustees limit the calculation of reproductive loss to a finite recovery period that assumes recovery mechanisms result in a return to baseline conditions. The debit was therefore not considered to be infinite. This methodology has been applied in previous oil spill cases and published in peer-reviewed technical literature.

Table 3 of the Bird and Wildlife Injury Assessment report lists all species included in the analysis of bird injury. Section 7.0 of the Bird and Wildlife Injury Assessment report includes a detailed description of the technical methodology used to estimate indirect injury, including literature citations. Item 6 in Section 10.0 addresses the issue of population dynamics relative to hypothetical biological recovery mechanisms such as density-dependence.

Comment 32: One commenter noted that the DARP contains inconsistencies with regard to density dependence, credits and debits of injury calculations, and species scaling.
Response: The Trustees note that biological recovery mechanisms may exist for the multiple species involved. However, it was not feasible to quantify the influence of such mechanisms on a per-species basis in the injury assessment due to the complexity of these mechanisms and the large number of bird species involved. Instead, the Trustees accounted for a variety of potential biological recovery mechanisms by making reasonable and conservative assumptions about recovery time-frames. Bird injury from production forgone is assessed using a standard annual discount rate of three percent.

The Trustees disagree with the commenter's assertion that there are inconsistencies in DARP calculations. Table 3 of the Bird and Wildlife Injury Assessment report lists all species included in the analysis of bird injury. Section 7.0 of the Bird and Wildlife Injury Assessment report includes a detailed description of the technical methodology used to estimate indirect injury, including literature citations. Item 6 in Section 10.0 addresses the issue of population dynamics relative to potential biological recovery mechanisms such as density-dependence.

Comment 33: One commenter stated that the Trustees would not know if using the alleged levels of oiling would result in assumed mortality. The lack of dead birds leads to the conclusion that fewer birds were killed or injured than projected through models. The commenter then stated that the multipliers used in other spills, often based on survey data, are much less than injury estimates in this case.
Response: The Trustees' estimates of mortality by exposure level and guild are based on peer-reviewed scientific literature and best professional judgment. Furthermore, spill-specific, tangible field evidence exists to document both population size and levels of exposure. See Section 6.2 of the Bird and Wildlife Injury Assessment report for a detailed description of the methodology used to derive spill-specific mortality estimates, including citations.

The Trustees addressed the potential applicability of a multiplier approach as detailed in Burger (1993).The multiplier approach is based upon a series of historical estimates.

However, in the *Athos* incident, the Trustees had extensive spill-specific field data to estimate mortality and concluded that the use of these data was preferred to a generic approach. In particular, see item 1 of Section 3.0 of the Bird and Wildlife Injury Assessment report for a detailed description of the limitations of the multiplier approach described by Burger and the rationale for the adoption of the selected method.

Comment 34: One commenter stated that Trustees included production forgone of bird populations, but this assumes that the surviving population cannot compensate (density dependence). Without considering population recovery with density dependence influences, loss is overstated.
Response: The Trustees note that biological recovery mechanisms may exist for the multiple species involved. However, it was not feasible to quantify the influence of such mechanisms on a per-species basis in the injury assessment due to the complexity of these mechanisms and the large number of bird species involved. The production forgone methodology has been used in past oil spill cases and published in peer-reviewed technical literature. The commenter's assertion that this model inherently overstates loss in incorrect. The Trustees accounted for a variety of potential biological recovery mechanisms by making reasonable and conservative assumptions about recovery time-frames.

Table 3 of the Bird and Wildlife Injury Assessment report lists all species included in the analysis of bird injury. Section 7.0 of the Bird and Wildlife Injury Assessment report includes a detailed description of the technical methodology used to estimate indirect injury, including literature citations. Item 6 in Section 10.0 addresses the issue of population dynamics relative to potential biological recovery mechanisms such as density-dependence.

Comment 35: One commenter asked how the birds who fed on polluted and not yet recovered intertidal mudflats and marshes were taken into account in the NRDA process. The commenter also asked how birds moving into the area in December 2004 and staying for months were represented and compensated for in the DARP. This commenter also wanted to know how models accounted for birds being more likely to freeze to death due to oiling causing loss of water-proofing of their feathers and why the reproductive failure for kingfishers was listed as zero. The commenter stated that the 27 wading birds impacted by the spill appears to be conservative and may not account for the true impact.
Response: The bird injury assessment addressed impacts to birds that were directly oiled during feeding, resting, and other activities; it did not address injuries for birds that may have been affected by exposure to oil via a food pathway. The Trustees did not believe that exposure via a food pathway was a significant source of potential injury based on the oil type and behavior. Injuries due to loss of food (i.e., affected invertebrate populations on intertidal mudflats) are addressed by the Shoreline Injury Assessment report.

The Trustees used a temporally dynamic three-time period model in estimating bird injury. Birds arriving in the impacted areas in December are assumed to have been exposed and died, have been exposed and survived, or not to have been exposed based upon time-period specific observed rates of oiling and estimated mortality rates. Section

6.4 of the Bird and Wildlife Injury Assessment report describes methods for accounting for survival and population flux. Figure 8 in Section 6.1 describes the initial aggregation of data to time-periods.

The Trustees used estimates of mortality rates by biological guild and level of oil exposure that were specific to this spill, including cold temperatures. Section 6 of the Bird and Wildlife Injury Assessment report includes a detailed description of the technical methodology used to estimate indirect injury. Section 6.2 of the Bird and Wildlife Injury Assessment report describes the specificity of the mortality estimates by guild and degree of oiling for the conditions at the *Athos* spill.

Indirect losses due to reproductive failure occur in birds that are oiled but survive and fail to breed in the subsequent year. The model indicated that one kingfisher was oiled but survived. This resulted in less than one lost bird in the reproduction failure model. Section 7.0 of the Bird and Wildlife Injury Assessment report includes a detailed description of the technical methodology used to estimate indirect injury, including kingfishers. Table 11 in Section 7.3 includes the results of calculations of indirect injury to kingfishers, including both lost production and reproductive failure.

The injury to wading birds was estimated using the same methods as for other guilds. Population estimates from aerial surveys for wading birds in particular were adjusted using ground survey data. Please see Section 5.5 of the Bird and Wildlife Injury Assessment report for a detailed discussion of efforts made to maximize the accuracy of the estimated population and injury of wading birds.

Comment 36: One commenter stated that bird mortality was estimated at 100% for trace oiled individuals, and asserts that this estimate is overly conservative. The commenter noted that using 100% mortality for moderate to severely oiled birds results in an estimated loss of 4,620 birds, not the 11,869 cited in the report. The report indicates that direct injuries totaled 3,308 adult birds, even less than the modeled 4,620 birds. The additional 8,561 lost birds were estimated based on assumed reproductive failure. The commenter felt that since habitat is modeled to be 99% recovered at this point, empirical data should be used to determine if bird populations have recovered to baseline levels, and that injury assessments for lost wildlife should be based on actual numbers recorded as a result of the event. The commenter then noted that further support of this overly conservative assertion is that the Report noted there were no significant fish kills or significant water column losses, leaving the food source intact for aquatic birds and other wildlife.
Response: Bird mortality was not estimated at 100% for all individuals. Estimated mortality rates based on degree of oiling are presented in Table 7 of the Bird and Wildlife Injury Assessment report. Rates are guild-specific, based on literature review and best professional judgment. For trace oiled birds, the mortality rate varies from 0-50 percent, depending on the susceptibility of the guild.

For the bird injury assessment, the levels of indirect injuries, while important, are small relative to the overall populations and are spread over a multi-state geographic region.

Even the three largest injuries are estimated to be a few thousand birds, out of hundreds of thousands of migratory and/or year-round residents. Measurement uncertainties related to observational techniques would overwhelm the estimated impact numbers. Because collection of population data was unlikely to reduce analytic uncertainty, the Trustees determined that it would not be cost-effective to proceed with further population assessments.

Estimated bird losses are calculated based on oiling of birds and the impact of this direct injury on reproductive ability (reflecting relevant technical literature and best professional judgment), not to loss of food supply. Injuries to habitat or food supply (water column or shoreline) are covered under the aquatic and shoreline injury assessments. The recovery of shoreline resources is a separate calculation from the loss of birds due to oiling.

Comment 37: One commenter requested that compensation for bird injuries be reduced, given the public perception of Canada geese as a nuisance species, and argued that compensation for nuisance and invasive species is in conflict with state and federal agency actions and statements. The commenter notes that in the Trustee response to RP comments on the Draft Final Bird and Wildlife Injury Assessment report (available from http://www.darrp.noaa.gov/northeast/athos/admin.html), "the Trustees decided to include nuisance and invasive species in the assessment '…regardless of their perceived service value,'" and further argues that this position would be inconsistent with agency guidance on damage assessments and basic economic principles. The commenter also stated in a footnote to the comment that an interim (draft) Trustee opinion to not include production forgone calculations for the estimated non-migratory Canada goose population in the injury assessment was inconsistent with the decision to include direct mortality estimates for that same population.
Response: The published draft DARP/EA makes no distinction between different groups of geese, as all Canada geese are protected under the Migratory Bird Treaty Act (MBTA).[52] While aspects of "nuisance" species' behavior are viewed negatively, they are a part of the ecological community and subject to protection from illegal takings.[53]

Consistent with OPA regulations, any injuries to Canada geese (direct or indirect) caused by the *Athos* oil spill are compensable. Restoration scaling for injuries to Canada geese is based on the resource-to-resource methodology specified in the OPA regulations, which does not require estimation of the "value" of the injured resource.[54] Regarding statements

[52] 16 U.S.C. 703-711
[53] The commenter appears to reference actions that have been taken under the authority of the U.S. Fish and Wildlife service to reduce populations of "resident" Canada Geese, among others. These actions are taken under specific legal requirements for population management and are legal takings, in contrast to the illegal takings in the *Athos* incident.
[54] Mute swans, also referenced by the commenter as a "nuisance" species, were not counted as a separate species during the injury assessment and are considered a minor part of the "swans/geese" category. They are estimated to be less than one percent of the overall swans/geese injury, based on their observation during aerial and ground surveys

made in interim Trustee reports, all such information is deliberative and subject to change.[55] No distinction between residential and other Canada geese is made in the published draft DARP/EA and the comment is therefore moot.

Comment 38: One commenter stated that to be more comprehensive, Table 4 in the DARP should include the other 6% of bird species that were observed to be oiled.
Response: The sole purpose of this table is to document the most commonly oiled bird species observed during ground surveys.

Shoreline Resources

Comment 39: Two commenters noted that various shoreline habitats provide services such as erosion protection and referenced the summary of shoreline services provided in Appendix A to the Shoreline Injury Assessment report. The commenters also note that the Trustees assert that 100 percent of baseline services were lost from areas impacted by heavy or moderate oiling. One of the commenters requested that these services be considered in the determination of "service reduction" for the various injured habitats and that the DARP be revised. If the DARP is not revised, the commenter requested a listing of weights assigned to each identified service, an evaluation of spill-related impacts to each marsh service, and a mathematical confirmation of 100% initial reduction of services. One of the commenters also requested how much ecological service rip-rap provides since it was claimed as a loss in the DARP.
Response: Trustee injury analyses incorporate the ecological and human use services that were adversely impacted by the spill. For example, a loss of production may occur with the oiling of macroalgae, and the detachment of insects and invertebrates removes a source of prey for fish that may feed along rip-rap. Ecological and human services that were not adversely impacted by the spill (e.g., erosion protection) are neither included in injury quantification nor restoration scaling analyses. The referenced table in Appendix A is noted as a summary of possible services, while the text of the Shoreline Injury Assessment report details the services that are used as a metric for evaluating injury. For shoreline habitat injuries, ecological service, mainly productivity, is the metric used to quantify injuries and therefore is the metric used to scale restoration. The specific service reductions at each time point for each habitat type are presented in Tables 6 to 10 of the Shoreline Injury Assessment report. The recovery curves (including rationale for identified service reduction values) are based on the habitat-specific service injuries identified in Sections 4.2 to 4.6 for each habitat type. The report is available from

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and their average degree of oiling. Again, any injury to mute swans due to oiling would be an illegal taking.

[55] Interim documents, which the Trustees have made available for this incident and others in the interest of making the NRDAR process publicly accessible and transparent, are not necessarily representative of the final decisions that the Trustees make. As documents are updated with new information, prior discussions may become moot. Additionally, interim documents may not have undergone the extensive review (both internal and peer) that is expected of a final document.

http://www.darrp.noaa.gov/northeast/athos/ admin.html. (These values are also summarized in the final Plan in Section 4.3.1 and Tables 7 to 11.) The relative values of habitat types were also considered in the scaling, since the majority of restoration proposed for shoreline injuries is to marsh. The relative weighting of each habitat type is shown in the final Plan in Table 20. The relative value of rip-rap habitat (as productivity) is estimated to be 10 percent of that of marsh habitat.

Comment 40: One commenter recommended including intertidal mudflats in Table 6 to better understand where this specific habitat is accounted for within the sand/mud substrate category. The commenter also questioned if any tidal mudflat projects were sought.
Response: Intertidal mudflats have been incorporated in the Shoreline Injury Assessment - sand/mud substrates (page 31 of the final Plan). No projects specifically dealing with restoration of intertidal mud flat areas were proposed during the restoration planning process; however, wetland restoration often results in the creation of some intertidal mudflat habitat. The Trustees expect a minimal amount of mudflat habitat will be restored in the Lardner's Point, Mad Horse Creek, and John Heinz Wildlife Refuge projects.

Comment 41: One commenter questioned whether service losses of shorelines were based on field studies or drawn from assumptions, and if based on assumptions, how that meets the OPA 1990 requirement that losses be observable and measurable. The commenter stated that they understood that the figures are based on past cases/studies, but questioned whether the extrapolation occurred correctly.
Response: The HEA inputs for the shoreline injuries are based on a combination of field observations, published studies of previous spills, professional judgment, and the life histories of intertidal fauna. The primary services being considered were food-web support and habitat usage. The heavy, weathered Venezuelan crude posed significant risks to intertidal fauna from smothering, fouling, and coating until the shoreline cleanup was terminated in spring 2005. Wide-scale re-oiling of the intertidal zone was observed through at least September 2005. The main assumptions are that oiled food items (reduced food quality) and oiled habitats (causes reduced viability or mortality due to physical fouling by entrained droplets or tarballs) do result in reduced ecological services. Once the oil was no longer mobile, the life histories of key fauna were used to estimate the rate of recovery.

Comment 42: One commenter stated that the shoreline injury assumptions were overly conservative. The commenter also stated that a different approach to categorizing oiling levels was employed for the *Athos* spill than for other spills, that these categories were not applied consistently, and that this resulted in overestimation of injury magnitude and duration. The commenter noted that Trustees assumed that the entire intertidal zone was exposed to oil by the stranded band on any segment and that this is not appropriate according to the universally accepted approach to SCAT when the SCAT is used to assume injury. The lack of precision and consistency translates several hundred direct oiling acres to thousands of acres.

Response: There is no "standardized" or universally accepted approach for defining SCAT oiling categories of heavy, moderate, light, and very light. The NOAA Shoreline Assessment Manual (2000) specifically says: *"Modify this matrix, especially the intervals for width of oiled areas, for specific spill conditions*." In fact, during the 2003 T/B *Bouchard-120* oil spill in Buzzards Bay, MA, the SCAT definitions of oiling categories used in the shoreline habitats damage assessment are the same as in the *Athos*. Examples of other spills where the NRDA oiling categories were based on SCAT data but modified to reflect spill-specific conditions include the 2000 Chalk Point spill in a tributary leading to the Patuxent River, MD; the 2000 *T/V Westchester* spill in the Mississippi River, LA; and the 2002 M/V *Ever Reach* oil spill in Charleston, SC. The Trustees carefully considered the degree of oiling for the different shoreline injury categories for the *Athos* spill when reviewing the results of studies of impacts from other spills.

The Trustees divided the intertidal zone into two categories for injury assessment: (1) the oiled band and (2) the lower intertidal zone below the oiled band. This approach was necessary for the *Athos* spill because of the oil type and behavior, the shoreline types that were oiled, the season of the spill, and timing of the different cleanup phases. The spilled oil was a very heavy, viscous oil that was highly persistent. It coated solid surfaces and penetrated into porous substrates, particularly the degraded rip-rap along the shoreline. This oil was frequently re-mobilized by tides and boat wakes. The oil created a thick band at the high-tide line, and extensive sheens and slicks of oil on the tidal flat observed on Tinicum Island on 29 November 2004 . The 29 November SCAT form for the shoreline segment (PA-7-C) indicated the oil as 6 feet by 1200 feet, 70% cover of tarballs and patties, and on the sand beach. The notes on the SCAT form say that the slick was being held up against the shore by the wind. However, at the time of the overflight, the thick oil had obviously spread onto the tidal flat, which was also covered with sheens and slicks. Tarballs/patties were rolling around in the swash zone as the tide was rising; thus the entire intertidal zone was being exposed to heavy oiling. Oil moving across the tidal flat on 2 November 2005, indicated on-going exposure to heavy amounts of oil. Flats adjacent to heavy oiling on the shoreline were definitely exposed to oil as it stranded and was remobilized. This degree of exposure would cause a reduction in ecological services.

During site visits in July and September 2005, the Trustee members of the Shoreline Assessment Team (SAT) observed numerous small tarballs surrounded by halos of sheen on tidal flats on Tinicum Island and along the PA shoreline, adjacent to shorelines that had been classified as heavy and moderate oiling. They also observed spots of oil on the salt marsh vegetation. The re-oiling of intertidal habitats was observed only on shorelines that had been classified as moderately and heavily oiled; oil was observed being released from rip-rap and other coarse substrates in these areas.

In a report prepared by Dr. Ann Rhoads of the Morris Arboretum of the University of Pennsylvania, oiling conditions were documented on the north side of Little Tinicum Island on 16 December 2004. She reported that "We saw very little oil on the surface of the tidal flats; however, anything that protruded from the surface had oil on it, including debris and plants. Plants that were visible on the tidal flats included dormant leaves of

spatterdock (*Nuphar advena*), sweetflag (*Acorus calamus*), arrowhead (*Sagittaria rigida*), arrow-arum (*Peltandra virginica*), and dwarf spike-rush (*Eleocharis parvula*). Black deposits of oil were visible on the leaves of many, but not all, of these plants."

Comment 43: One commenter asked for clarification on whether shoreline segments were broken down into sub-segments by oiling category or if entire segments were considered the same as the most heavily oiled sub-segment.
Response: The *Athos* Shoreline Injury Assessment report states (p. 14): "To calculate the total shoreline areas injured by the exposure category, the total length of shoreline within each exposure category was calculated. The length of oiled shoreline was obtained by overlaying the Environmental Sensitivity Index (ESI) habitats onto the maximum oiling maps and generating lengths using a GIS application."

The maximum oiling maps referred to in this sentence were the maps built from the SCAT data sheets, and these maps already incorporated sub-segments or zones (e.g., A, B, C, and D) within a segment (e.g., NJ-1, NJ-2). The oiling was digitized based on sub-segments and the maximum oiling map shows the maximum oiling across all of the dates that SCAT surveys were conducted. Thus, the maximum oiling maps and data do not overestimate shoreline oiling; rather, they reflect the highest resolution of the SCAT data.

Comment 44: One commenter stated that including tributary surface waters as injured shoreline acres overstates the impact to tributary shorelines. Many of these areas are subtidal, were not exposed to oil, and cannot suffer the same magnitude and duration of impacts of intertidal shoreline sediments that hold PAHs. The Aquatic Technical Working Group (ATWG) attributed no injury to surface waters, while the Shoreline Technical Working Group did. The commenter also states that the draft DARP/EA suggests more acres of oiling in tributaries of the Delaware River than the mainstem.
Response: Very early in the process the decision was made that the Shoreline Technical Working Group (STWG) would be responsible for assessing injury to the tributary creeks that were affected by the *Athos* spill. This decision was based on the acknowledgement that these shallow wetlands should be considered as "systems" consisting of a shoreline composed of fringing salt marshes, isolated wetlands, very shallow benthic habitat, and open water. With a narrow intertidal zone, animals using these systems spend most of their time either on the water surface or in the shallow water column. The fringing marsh edge (where the oil adhered to the vegetation) provides important shelter for juvenile fish and shellfish that overwinter in these systems. The tributaries provide ecological services very different than the open main stem of the Delaware River. Sheltered from strong currents and waves, the tributaries are shallow and thus provide access to benthic food items, while the marsh fringe provides shelter. These habitats are closely linked and it would be inappropriate to artificially separate them into "salt marsh," "intertidal mud," "water surface," and "bottom." Surface water is not included as a discrete category of the injury. The tributaries are narrow and have low dilution and flushing rates, thus oil in these systems would affect a significant percentage of the animals present. These conditions are very different that the large dilution and rapid flushing of the main stem of the Delaware River. Based on the observed degree and duration of oiling in the tributaries, and the types and life histories of the animals that reside there, the Trustees

developed very specific HEA inputs for these important tributary habitats and the ecological services they provide. The initial service losses occurred during the 3-month period that sheens were observed in the tributaries, and all services were predicted to recover within 1 year.

Based on the ecological characteristics of the tributaries, a much larger relative area of impact occurred in those areas than in the main stem. Impacts in the Delaware River were primarily restricted to the shoreline areas, whereas the conditions in the tributaries led to a greater degree of exposure. Overall, the Trustees estimate a slightly larger area in the Delaware River (2,142 acres of shoreline and subtidal) versus 1,899 acres of tributary habitat. The Trustees disagree with the argument that these calculations are inconsistent with information from the Aquatic Technical Working Group (TWG). The Aquatic TWG only analyzed one sediment sample from a tributary to the Delaware River for full PAHs. This sample was from the Schuylkill River, which is not included in the tributary injury assessment and is a major urban river (and as such, more similar in flow characteristics to the Delaware River than to the tributaries evaluated by the Shoreline TWG).

Comment 45: One commenter stated that the shoreline injury assessment indicated that 50-100% service losses in sand/mud substrates occurred and that it would take 3 years to recover from the spill, when chemical analysis in the same locations did not support loss approximately a month following the spill. The commenter also noted that other site-specific PAH data did not indicate injury, nor was it observed or measured. The commenter also asserted that there were inconsistencies between the shoreline and aquatic assessments, where the Shoreline Technical Working Group (TWG) considered fouling as the injury mechanism (based on assumptions) while the Aquatic TWG considered it to be toxicity (based on oil properties, bioassays, chemical analysis of sediments, and PAH literature). The commenter called for evidence of fouled organisms and their inability to recover for up to 1 year.
Response: The pathway of exposure for intertidal resources is via physical fouling by oil sheens, droplets, tarballs, etc. The heavy Venezuelan crude oil that was released from the *Athos* had a very high "oil fouling potential." Furthermore, the chronic re-releases of oil from sediments until at least September 2005[56] resulted in additional impacts and lost services during this period of "natural weathering" of the oil stranded on the intertidal habitats (for example, see Figures 11 and 12 in the Shoreline Injury Assessment report). This pathway is very different than exposure of benthic infauna to PAHs via dissolution into and uptake from pore water in benthic sediments, on which sediment quality guidelines are based. The thick, viscous oil from the *Athos* did not readily penetrate sediments; rather it coated, covered, fouled, and smothered intertidal animals, plants, and substrates. This oiling resulted in reduced ecological services, direct mortality of intertidal fauna, reduced survival of intertidal fauna, and reduced prey value. The recovery trajectory includes both the recovery of initially oiled organisms based on life histories and the impacts of re-oiling. Fouling effects continued for nearly 1 year, based on field site visits conducted in September 2005 where continued re-oiling of intertidal

[56] September 2005 was the final formal investigation of shoreline oiling.

habitats was observed. In the Aquatic TWG's assessment, both potential effects of PAHs and of physical fouling are considered, consistent with the Shoreline Assessment Team.

Comment 46: One commenter requested the name of the six tributaries in New Jersey that were impacted by oil. The commenter also stated that these six tributaries do not include the scope of all tributaries that were injured by the spill. Based on their visual assessments, at least 14 tributaries were impacted. The commenter also questioned how the tributary surveys were completed, if ground-truthing was involved, at what timeframe, and for how long and how often each tributary was surveyed. The commenter also stated that combining all tributary habitat types into one may be less protective than if they were evaluated separately because an important habitat type may be eliminated. The commenter asked why no acreages were listed for the lower intertidal and tidal flat reaches of tributaries.
Response: The six tributaries included in the assessment are Big and Little Timber Creek, Woodbury Creek, Mantua Creek, Raccoon Creek, Old Canal, and Oldmans Creek. These tributaries had enough oil exposure to have resulted in injuries, based on shoreline and aerial surveys. While oiling may have been observed in other tributaries, insufficient exposure occurred to result in quantifiable injury. The oiling category for the tributaries was assigned based on the following information: the observations from daily aerial surveys from 29 November to 13 December 2004 on the extent and degree of floating oil were reviewed; and SCAT surveys were reviewed for information on the degree of shoreline oiling. Each state provided guidance on the upstream extent of oiling and degree of oiling based on ground surveys by their staff. The moderate oiling category consisted of moderate oil along the shoreline based on SCAT surveys and observations of black oil slicks on the water during aerial surveys. The light oiling category consisted of light to very light shoreline oiling based on SCAT surveys and aerial observations of extensive dull to rainbow sheens on the water. The very light category was based on aerial observations of the presence of extensive rainbow to silver sheens on the water. The Trustees specifically treated the tributaries as "systems" because of the close linkages between the habitats in them. This was the best approach to account for all important habitats within the tributaries.

Comment 47: One commenter stated that it did not seem possible for tributary habitats to recover after 1 year, as described in the draft DARP/EA.
Response: The Trustees believe that the tributaries recovered in 1 year because no oil residues in intertidal sediments or on vegetation were found during site surveys in the summer of 2005, and subtidal sediment samples collected in September 2005 showed no significant contamination with oil from the spill.

Comment 48: One commenter questioned whether 3 years was a fair recovery rate for intertidal mud flats and if the recovery rate would be uniform since mud flats experienced different levels of oiling. The commenter asked about the 5-year time period for heavily oiled rip-rap recovery, and how it takes 4 years for heavily oiled marsh recovery versus 3 years for mud and sand substrates. The commenter questioned whether tributaries would recover at varying rates. The commenter also asked if DSAY calculations would undervalue mud flat and tributary habitat and wondered about the habitat type for gravel.

Finally, the commenter inferred that DSAY calculations for habitat may have been unfairly negotiated with regards to recovery time.
Response: The recovery rates for habitats do vary by degree of oiling. However, the time to full recovery is based on the life histories (age structure, reproduction rates) of the fauna that were most likely affected in that habitat. In this incident, estimated marsh recovery times were aided by the lack of oiling observed on vegetation due to the time of year of the spill. In contrast, heavily oiled rip-rap takes significantly longer to recover its natural baseline due to the effects of the cleanup (high-pressure, hot water flushing). Gravel substrates are included in the "coarse substrates" habitat type. No negotiations occurred regarding recovery times for habitats; these estimates are based on observations from past spills and literature results.

Comment 49: One commenter asked what species of turtles were found dead.
Response: The three turtles that were found dead or died were: Painted turtle (1), snapping turtle (1), and species unknown (1).

Comment 50: One commenter expressed concern that the Trustees failed to take into account the additional services produced from restoration, above those services being compensated for. The commenter then stated that the Trustees' failure to account for those services is troubling in their use of habitat exchange ratios reported in Peterson et al. 2007. The commenter asserts that the Trustees use the 2.5:1 ratio rather than the 3.1:1 ratio that should be used if bird services are considered. The commenter asserts that this would result in 80% of the services flowing from the mallard restoration project to be credited against shoreline and aquatic debits.
Response: Tidal flat injuries are expected to adversely affect aquatic-based food webs. Therefore, it is appropriate to limit compensatory restoration scaling calculations for this injury to aquatic-based improvements from the preferred projects (marsh enhancement). The Peterson 2.5:1 ratio is consistent with this approach. The Peterson 3.1:1 ratio adds in benefits to terrestrial fauna. Any terrestrial-based benefits arising from restoration projects are considered incidental, and would be used to offset terrestrial-based injuries if there were any for this spill.

Recreational Resources

Comment 51: Two commenters suggested that the lost use injuries (specifically, reductions in waterfowl hunting trips) resulted in a net gain to ducks and geese, and that this gain must be used to offset the direct injury calculations for these species. They argue that once the compensation for the loss of hunting-based recreation is calculated, any resulting increase in bird populations due to reductions in hunting must be credited toward the bird injury in order to avoid double-counting. One commenter also notes that this proposed credit offset from reduced hunting trips for waterfowl should be used to compensate for injuries to non-waterfowl species, mainly gulls.
Response: The commenters' suggestion, that the estimate of the number of birds killed by the oil be reduced by the number of waterfowl that may not have been killed because of hunting restrictions resulting from the spill, is inconsistent with the law and public policy. OPA provides that parties responsible (RPs) for an oil release are liable for

natural resource damages; the statute further provides that the Trustees shall assess incident-related damages to natural resources under their trusteeship and develop and implement plans for the restoration of those resources. The commenters' proposal equates birds legally killed as a result of a licensed and closely regulated recreational activity which is encouraged and valued by society, with the unlawful, unpermitted take of birds killed by the discharge of oil (*See*, Migratory Bird Treaty Act (MBTA)). It is inappropriate to grant credit under one law (OPA) for actions that violate another law (MBTA).

The commenters' suggestion also disregards the acknowledged functions and importance of migratory birds in the United States. Executive Order 13186_ (1/10/01) entitled Responsibilities of Federal Agencies to Protect Migratory Birds, issued in furtherance of the purposes of the Migratory Bird Treaty Act (16 U.S.C.§§703-711), the Fish and Wildlife Coordination Act (16 U.S.C. §661-666c) and the Endangered Species Act of 1973, (16 U.S.C.§1531-1544) provides in relevant part:

> Migratory birds are of great ecological and economic value to this and other countries. They contribute to biological diversity and bring tremendous enjoyment to millions of Americans who study, watch, feed, or hunt these birds throughout the United States and other countries. The United States has recognized the critical importance of this shared resource by ratifying international, bilateral conventions for the conservation of migratory birds….
> (Emphasis supplied)

In recognition of the importance and societal benefits of wildlife-associated recreation such as hunting, Congress, pursuant to the Federal Aid in Wildlife Restoration Act, 16 U.S.C. § 669 *et seq*., annually appropriates funds to the U.S. Fish and Wildlife Service, Wildlife and Sport Fish Restoration Program (WSFR). The WSFR works with states by providing grants to conserve, protect, manage and enhance fish, wildlife and their habitats and to ensure the public's right to use and enjoy them through activities such as hunting, sport fishing and recreational boating. Federal and state agencies manage programs that license, protect and enhance the rights of hunters to recreate. These agencies expect and plan for the killing of birds by recreational hunters. They establish and modify, as appropriate, policies (e.g., restrictions re: when and how many birds may be killed by hunters) to conserve and manage wildlife and their habitats for the use and enjoyment of current and future generations. Thus the 4,700 bird hunting trips which the public lost because of the spill were legally sanctioned hunting trips.

Even if the Trustees had accurate information regarding the number of birds not killed as a result of the reduction in hunting trips (which they do not) and if the species of birds not killed as a result of not being hunted were the same as the species killed by the oil spill (which they are not), it would be inappropriate to reward RPs by giving them credit for the birds not killed as a result of their actions which caused the public to suffer the loss of legally authorized and encouraged recreational opportunities and which, in effect, usurped the role of agencies tasked with conservation and management of wildlife for activities such as hunting and fishing and regulation of those activities. Such a credit

would be entirely inconsistent with the law and public policy.

In addition, allowing the suggested "credit" could create a perverse incentive for RPs. For example, in situations where an RP believes that it would be less costly to pay for lost recreational use of natural resources than to directly restore lost or injured natural resources, the "credit theory" could encourage the RP to permit oil to migrate into an area where it directly impacts wildlife-associated recreation such as fishing or hunting. RPs might allow or encourage this situation based on a determination that their total monetary liability would be reduced by paying for lost fishing or hunting opportunities and receiving an automatic credit for the fish and/or wildlife not killed by fishermen or hunters, rather than funding projects to restore the resources killed or injured by their spill. Such actions should not be encouraged and cannot be rewarded.

Comment 52: One commenter stated that the proportions lost, substituted, and degraded of recreational trips may be affected by the weighting scheme and outliers due to small sample sizes of recreational users. The commenter also stated that since this was used in damage estimates, details regarding the interpretation of the data and extrapolation to the population have a large effect on the damage estimate.
Response: As outlined in the "*Athos*/Delaware River Lost Use Valuation Report," available at http://www.darrp.noaa.gov/northeast/athos/admin.html, a variety of weights were applied to the data, depending on the type of recreational use and how data were collected for that recreational use. For fishing/crabbing trips, two weights were applied to account for on-site sampling. The first applied the inverse of the number of trips taken by the respondent to adjust for the possibility that more frequent anglers/crabbers would be observed at a higher rate; the second used the inverse of trip length to account for the higher likelihood of intercepting individuals taking longer trips. An additional weight accounted for the number of people traveling with the intercepted angler, thereby adjusting for group size. Boating trips did not include a weight for the number of trips or length of trips since most of the intercept surveys occurred when boaters were at the marina, but not engaged in a boating trip. As with the fishing data, however, a weight was applied for the number of people in the group. The waterfowl hunting assessment did not use a weighting scheme as it was conducted on a random sample of licensed hunters. Data were extrapolated to the larger license-holding population through use of a ratio of the total license holders to number of license holders contacted in the survey. Results from this random sample were extrapolated to the additional counties impacted by the spill using data from the Harvest Information Program by the U.S. Fish and Wildlife Service.

All of the data were inspected, identifying uncertainties, and resolving uncertainties in a manner leading to a lower-bound estimate of affected trips. During this process, no outliers were identified and determined to be numerically distant from other related observations. For further information on the weighting scheme and extrapolation please see the above referenced "*Athos*/Delaware River Lost Use Valuation Report."

Comment 53: One commenter stated that using baseline recreational user data from April to October would overestimate recreational losses since the spill occurred in winter.

Two other commenters stated that the number of recreational trips lost or diminished is too high given the winter timing of the spill, and that boating trips could have shifted location. One of the commenters stated that the period of loss projection was unclear..
Response: Three surveys were used to estimate the baseline level of recreational fishing/crabbing use in this analysis: (1) 2002 Delaware River Creel Survey for angler activity from the impact area south to Wilmington, DE; (2) Marine Recreational Fisheries Statistics Survey (MRFSS) for trips south of Wilmington, DE; and (3) New Jersey Blue Crab Recreational Fishing Survey of 2005 for crabbing trips in Salem County, NJ.

The data from the 2002 Delaware Creel Survey were adjusted using a regression model to account for the day and time in the recreational fishing season, as well as the site. This process allowed for the allocation of baseline trips to the three time periods used for temporal stratification in the analysis of lost/affected trips. The Trustees used temporal stratification of the estimate of lost trips into these three time periods to account for the possibility of changing spill impacts over time (e.g., the possibility that the highest percentage of trips might have been affected in the time period closest to the time of the spill).

MRFSS data were adjusted for monthly weekday and weekend angling pressure (obtained from the National Marine Fisheries Service) and allocated to the appropriate time periods. The New Jersey crabbing data were divided by time period, which allowed for allocation of these trips to each of the three time periods discussed previously. Then the percentage of trips lost during each time period from the survey respondents was used to determine the number of lost trips.

The absence of baseline data for months prior to April 2005 leads to an underestimate of affected trips and an underestimate of losses due to the spill. The estimate of affected trips represents an underestimate because the percentage of affected trips for Period 1 is calculated for the entire period following the spill until 12 June 2005, based on the sample of people interviewed. This percentage was then multiplied by an estimate of total baseline trips that omits activity in the months prior to April 2005. This leads to a lower estimate of affected trips than would be calculated using an estimate of baseline trips that includes the entire period following the spill. Since the interviews did not collect information on affected trips by month, a breakout of effects before and after April was not possible, and this lower-bound estimate is the most valid way to estimate losses due to the spill.

Baseline use data for the waterfowl assessment were obtained from the random sample of license holders, with extrapolation to the larger license-holding population in the six-county impacted area using the Harvest Information Program data from the National Marine Fisheries Service. Similar to the recreational fishing surveys, the waterfowl survey specifically asked people how many trips they typically take to the Delaware River and associated marshes and how many fewer trips were taken to those locations in the 2004/2005 hunting season because of the spill.

Baseline number of boating trips was estimated by multiplying the number of moored boats times the daily rate of use of moored boats. The baseline data used for boating effort in this analysis were collected in surveys conducted on 3-4 September 2005 at peak weekend use. The estimate of the rate of use of moored boats obtained from the onsite surveys (11.2%) was assumed to reflect the late summer rate under baseline conditions; this rate also was similar to the baseline rate of use in other recreational boating studies. The weekday use was assumed to be 25% of this figure.

The number of trips lost was directly obtained from individuals during the intercept (recreational fishing and crabbing, and boating) and telephone (waterfowl hunting) surveys conducted in 2005 and 2006 (fishing only). These surveys also included questions about the ongoing effects from the oil spill. The spill happened during the late fall of 2004, but the impacts continued into the 2005 and 2006 seasons, as indicated by these surveys. No effects were estimated for 2006, as stated in the "*Athos*/Delaware River Lost Use Valuation Report," since none of the respondents to the 2006 survey indicated changing their trip location or taking fewer trips. Substitute trips, or shifting to other locations, are included in the total number of affected trips and viewed as a loss equivalent to forgone trips since the value per trip estimates used in the literature are derived from models that consider the process of substitution between sites. The "ease" of substitution for the site would depend on the specific characteristics of the angler as well as the preferred site for recreation.

See the "*Athos*/Delaware River Lost Use Valuation Report" available at http://www.darrp.noaa.gov/northeast/athos/admin.html for further information about this analysis as well as the survey forms.

Comment 54: One commenter noted that estimating the number of trips based on the number of moored boats inflates trip numbers and that using national values for boating estimates was inappropriate because the area under consideration involves less recreation than shipping activities. The commenter also stated that Trustees misapplied models to estimate lost recreational use.
Response: The analysis of recreational boating did not rely solely on the estimate of number of moored boats to estimate boating activity. Instead, the analysis also included data on the average rate of use of moored boats, which, in combination with the count of these boats, allowed an approximation of the actual boating activity in the study area (see response above for more detail).

The "*Athos*/Delaware River Lost Use Valuation Report" indicates the reasons that the benefit transfer value employed in the assessment is appropriate. Benefit transfer from existing literature is a cost-effective method for arriving at a value of lost use that has precedent and can be appropriate in natural resource damage assessments. The Delaware is a large river with both boat-based and shore-based recreational opportunities; however, it is also a river with a history of industrialization and contamination. Therefore, there might be some aspects that increase its desirability to the population and others that decrease its desirability to the population relative to other available substitutes. The Trustees chose to use benefit transfer to balance the need for an accurate value with a

desire for cost effectiveness. The limited literature about boating value in the Northeast (one study) required an expansion of scope to look at the multiple available studies (nine) on the national level. The average of the values obtained from these studies is an appropriate strategy for obtaining a boating value for this assessment. See the "*Athos*/Delaware River Lost Use Valuation Report" available at http://www.darrp.noaa.gov/northeast/athos/admin.html for further information about this analysis as well as the survey forms used to collect data on the number of trips affected from the time of the spill onward.

Restoration Scaling, Planning, and Projects

General

Comment 55: Two commenters wrote in support of the Lardner's Point restoration project.
Response: The Trustees note the support.

Comment 56: Four commenters wrote in support of the Darby Creek restoration project.
Response: The Trustees note the support.

Comment 57: One commenter noted that Delaware Riverkeeper should be changed to Delaware Riverkeeper Network.
Response: This correction has been made in the final Restoration Plan.

Comment 58: One commenter noted they would like to see funding go towards reestablishing the warning flood buoys along the river, and/or allocated to other rivers in Pennsylvania that were disconnected this past year due to lack of funding. The commenter suggested removing at least one of the preferred projects in the Restoration Plan to fund the flood warning system.
Response: The re-establishment of the warning buoy system is not within the scope of the natural resource damage assessment restoration guidelines. The goal of restoration under the Oil Pollution Act is to implement actions appropriate to restore, replace, or acquire natural resources or services equivalent to those injured by the *Athos* spill (S*ee*, 33 U.S.C. 1006(d)(1)). Accordingly, the projects proposed in the Restoration Plan were developed to compensate the public for injuries incurred due to the *Athos* oil spill in 2004.

Comment 59: One commenter stated that the only freshwater wetland project included in the list is Lardner's Point.
Response: The Heinz National Wildlife Refuge restoration project is in a tidal freshwater marsh.

Comment 60: Some commenters noted that the RP was not involved in the NRDA after the Trustees developed their injury determination, so the RP was not given a sufficient

opportunity to participate in the Trustees' restoration project screening, scaling, and selection process.
Response: From the beginning of the NRDA process, the Trustees undertook significant efforts to meet their regulatory requirements to coordinate with the RP. Multiple examples of Trustee correspondence, as well as detailed responses to RP comments to data reports and assessments, are outlined at NOAA's website. http://www.darrp.noaa.gov/northeast/athos/admin.html During this correspondence, the RP continually noted that it had met its limit for liability under OPA, so it was no longer required to pay for additional studies and documents, such as the NRDA. Accordingly, the Trustees agreed that they should coordinate with the RP as a member of the public, rather than as an interested party.

The Trustees' decision to end the RP's direct participation in the NRDA process was based on several factors. First, the Trustees considered OPA's requirements on coordination with RPs (*See*, 15 C.F.R. § 990.14(c)(5)). In this case, the RP provided $100,000 in funding for the Trustees' earlier data collection projects, so that it should be granted a full cooperative role in the assessment – even though the great majority of RP funding was devoted only to spill response expenses. Although the OPA implementing NRDA regulations strongly encourage formal agreements between trustees and responsible parties (to ensure cooperation and cost-effectiveness), initial RP funding does not guarantee their participation in an NRDA. Instead, OPA provides that the scope of RP participation in document development must be determined by the Trustees. OPA's regulations provide a number of factors to assist Trustees in making this determination, which include: (1) the willingness of responsible parties to participate in the assessment and provide funding for assessment activities; (2) the ability of the RP to conduct assessment activities in a technically sound and timely manner and to be bound by the results of jointly agreed upon studies; (3) the degree of cooperation in response activities; and (4) the actions of the RP in prior assessments. In reference to the first criteria, the RP declined to fund past or future Trustee costs associated with the NRDA and NRDA pre-assessment activities (*See*, RP letter May 24, 2005, p. 2). This action demonstrated a lack of willingness on the part of the RP to engage with the Trustees in a cooperative manner. Secondly, the Trustees determined that they were best served by seeking independent peer reviewed studies – a decision that is within their discretion. Next, it is acknowledged that the RP continued with the spill response activities beyond the point that its liability limits. Finally, the actions of the RP in prior assessments were not a factor in this case. Accordingly, the Trustees met the OPA coordination requirements by inviting the RP to become part of the DARP process, and by responding to inquiries and comments raised by the RP regarding the injury assessment.

Finally, like all members of the public, the RP was provided the opportunity to comment on proposed restoration projects during the public comment period.

Comment 61: One commenter noted that the RP had no prior notice on one of the Trustees' largest projects – the Mad Horse Creek project.
Response: Some of the proposed restoration projects in the draft DARP/EA were identified later in the planning process than others. No member of the public was given

notice of the Mad Horse Creek project until the draft DARP/EA was published for review.

Comment 62: One commenter stated disappointment that the Evergreen Stipson's Island Mitigation Bank did not make the list of preferred alternatives. The commenter stated that the low score did not appear to be based on an informed analysis and that private sector initiatives could implement restoration projects in a more efficient manner.
Response: The use of Stipson's Island Mitigation Bank credits must be reviewed and recommended for approval by the Mitigation Bank Review Team, composed of the U.S. Army Corps of Engineers, National Marine Fisheries Service, U.S. Fish and Wildlife Service, Environmental Protection Agency and New Jersey Department of Environmental Protection. Although this project went through the screening process in the draft DARP/EA, at the time of project review neither the site plans nor the banking instrument had been approved by the interagency Review Team. Further, the mitigation bank proposal was originally developed to address legal requirements that differ from the cleanup context. The bank was intended to provide mitigation for impacts resulting from permit actions issued by the USACE under the River and Harbors Act (Section 10) or a Clean Water Act (Section 404) permit, or a related permit from NJDEP. The bank was not set up to provide mitigation for natural resource damage projects or cleanup impacts.

Comment 63: One commenter noted that full recovery is estimated to have occurred by 2009, and states that this report is not justified in using models and estimates when real data are available. The commenter also stated that restoration and recovery for injuries are only appropriate for any areas still impacted by the event.
Response: The natural resource damage assessment process ensures that the public will be compensated for injuries to natural and recreational resources and services, including: (1) the cost of actions needed to return injured resources and resource services to baseline condition; and (2) losses arising from the degraded condition of injured resources until those resources and resource services to return to baseline levels. The commenter's statement that restoration is only appropriate for areas still impacted by the oil spill is incorrect. Further, as detailed in the draft DARP/EA, the Trustees collected and evaluated a large amount of spill-specific field data as part of the damage assessment process. The goal of the Trustees is to assess interim losses in a timely and cost-effective manner to compensate the public. Modeling and professional judgment are necessary to do this. The Trustees determined that additional data collection efforts, beyond those already undertaken, were unlikely to reduce analytic uncertainties, would unnecessarily delay restoration implementation, and therefore were not cost-effective Each of the nine proposed restoration projects is necessary in order to fully compensate the public for resources and services lost as a result of the *Athos* spill, even for resources that have returned to baseline by 2009.

Comment 64: One commenter believed the twelve-month time frame for implementation was not a reasonable criterion for screening potential restoration projects since the projects were first solicited in January 2006. Preliminary projects that were suggested in 2006 could have been planned for and developed within the timeframe of the NRDA process but may have been prematurely disqualified.

Response: The criterion used in the project selection is defined as "is there sufficient information about the project available to allow evaluation with the OPA and NEPA criteria **and** enable implementation **within 12 months of the finalization of the restoration plan?**" At the time the restoration planning process was underway, many of the projects proposed were not developed in sufficient detail to allow evaluation with the OPA and NEPA criteria and therefore were not considered under this plan. It is difficult to forecast the timing of the restoration planning process. The Trustees have considered information about potential projects made available during the restoration planning process, up to and including the public comment period. Proposed projects must contain sufficient detail to evaluate their ability to meet OPA and NEPA requirements.

Comment 65: One commenter noted there should be more restoration projects in the injury area – specifically along tidal New Jersey tributaries, which have a direct nexus to spill impacts. The commenter then stated the restoration of small tidal freshwater wetlands nearer the impact zone may create larger water quality benefits, particularly since these areas would help filter out pollution from adjacent industrial sites.
Response: Restoration projects were solicited through a formal process with a Notice of Intent to Conduct Restoration Planning and by letters requesting project ideas sent to local stakeholders involved in restoration in the Delaware Region. The Trustees also put forward restoration ideas for consideration. All projects went through a screening process and then were scaled to ensure that injuries resulting from the spill would be addressed by the suite of proposed projects. Projects were evaluated and selected from those submitted during the initial restoration planning process. Those selected passed the Tier 1 screening and scored highest on the Tier 2 screening. Although proximity to the spill was a criterion used in the selection process, there were a total of 15 criteria used in Tiers 1 and 2 of the selection process. Potential for water quality improvement was not a criterion directly used in the selection of projects. Criteria used in the ranking were selected based on Oil Pollution Act regulations and additional criteria deemed appropriate by the Trustee Council. Projects were not selected based on their ability to filter out pollution from adjacent industrial sites since there were no significant water quality injuries involved in this incident.

Comment 66: One comment suggested that efforts be made to encourage and use volunteer manpower where appropriate. In general, turning to nonprofit organizations for expertise, organization, and implementation, and the inclusion of volunteer labor will stretch the benefits and value of every NRDA dollar spent as opposed to using those funds to pay for profit entities for expertise and implementation. This should be an important element in present and future project selection.
Response: The Trustees recognize the value in engaging volunteers and volunteers will be used when practical. But, Trustees cannot request funds for money not being used, i.e., for work that volunteers would do. All funding requested is allocated to specific tasks related to the restoration projects.

Comment 67: One commenter requested the opportunity to review restoration project plans as they develop further for each project.

Response: Unfortunately, the Trustees cannot offer every interested party the opportunity to review project design plans. However, each restoration project will be reviewed by members of the Trustee Council and other experts in the restoration field. All projects must receive the required federal, state, and local permits for implementation.

Restoration Project Costs

Comment 68: One commenter stated concern with the high cost of the Mad Horse Creek restoration project. The commenter also stated that the long-term viability of controlling and managing *Phragmites* should be weighed with the long-term benefits and results. The commenter also noted that components of this project are valuable but without more detail on the project plans, the cost efficiency is in question.
Response: The cost for implementation of the Mad Horse Creek project is comparable to recently implemented restoration projects of the same restoration type and project location. These costs include restoration of approximately 60 acres of wetlands, 35 acres of wet meadow and 100 acres of grassland habitat. Detailed engineering costs estimates have been developed to fully justify this cost and will be submitted for approval to the NPFC. Control of the invasive species *Phragmites* will be accomplished through restoration of proper tidal flushing and lower marsh elevations. This method has been shown to be successful in the control of this species in numerous wetland restoration projects.

Comment 69: One commenter asserted that Trustee costs were overstated by overlapping the fiscal needs of multiple agencies over multiple years, resulting in a high cumulative cost. The commenter favored private sector mitigation, which would be a one-time cost, with all monitoring and maintenance the responsibility of the private sector mitigation provider.
Response: The private sector will be involved in restoration implementation. Nevertheless, all Trustees have a legal obligation to oversee the restoration implementation process. The budgeted costs are necessary to meet this obligation, and cannot be transferred to another entity.

Comment 70: One person commented that the Trustee Council oversight cost total ($2,145,292) equals approximately 8.8% of the restoration cost and seems excessive.
Response: Trustee oversight costs are based on past experience and best professional judgment of the Trustees on this case. These costs are deemed necessary to adequately cover reporting requirements and to maximize project success.

Comment 71: One commenter noted that the monitoring and oversight should be subsumed within the valuation of injury, i.e., that the cost of selected restoration projects should be scaled back so the value of Trustee oversight can be included in restoration project costs. The commenter noted it is inappropriate to increase the valuation of injury with administrative costs associated with implementing the projects.
Response: The recreational projects were scaled using the value-to-cost approach authorized by OPA, under which an amount of money equal to the value of recreational

services lost due to the spill will be spent on projects to enhance recreational services (including any monitoring required for these projects). The ecological projects selected in the draft DARP/EA were scaled using a service-to-service approach, also authorized by OPA and preferred for this type of loss, such that required compensation is equal to the cost of restoration projects (including appropriate monitoring) sufficient to restore the ecological service lost due to the spill. Trustee oversight costs for project implementation, including monitoring success and oversight, are an appropriate authorized cost under the Oil Pollution Act.

Comment 72: One commenter felt there was not enough detail in the draft DARP/EA to evaluate how Trustees calculated monitoring and oversight costs. The commenter asserted that there was no detail provided to back up the costs outlined, but that the public has a right to know whose time is assigned to costs and how the figures were derived.
Response: This information will be included in the detailed cost estimates submitted to the NPFC and will be approved prior to project implementation. The level of cost detail provided in the draft restoration plan is consistent with prior restoration plans. Detailed costs have not been released to the public. Projects may undergo a competitive bid process to award construction contracts; providing detailed estimates of project costs to the public could inappropriately influence the bidding process in the future.

Comment 73: One commenter noted that Table 48 (Trustee Council Oversight Costs) would be more user-friendly if it included row and column totals or if the text included some reference to the overall costs.
Response: The comment has been incorporated in final Plan.

Comment 74: One commenter questioned the inclusion of contingencies of 25% in the total project costs, given the expertise and experience that the Trustees have with these types of projects.
Response: The Trustees used guidance on contingency funds from NOAA and the U.S. Army Corps of Engineers to determine the appropriate level of contingency funds requested. Contingency funds are designed to cover unexpected and unanticipated costs. The inclusion of contingency costs is a common engineering practice. Finally, contingency funds are only released by the NPFC upon sufficient demonstration that their use is warranted.

Comment 75: One commenter noted it is inappropriate to build a 25% contingency into the damage assessment and that the NRDA process may have been reversed, i.e., the selected restoration projects influenced the valuation of injury. The commenter noted that contingencies may have come into use because of the nature of trustee-responsible party settlements, and are added in because the trustees do not always have the ability to go back to settling with responsible parties for additional funds. This commenter also noted that the contingency could result in a waste of taxpayer money.
Response: The Trustees did not include the costs of implementation in the valuation of the injury resulting from the spill. The Trustees used guidance on contingency funds from NOAA and the U.S. Army Corps of Engineers to determine the appropriate level of contingency funds requested. Contingency funds are designed to cover unexpected and

unanticipated costs. The inclusion of contingency costs is a common engineering practice, and the level of contingency funding requested is consistent with similar projects proposed in other draft DARP/EAs. Lump sum contingency costs will not be provided to the Trustees at the time the claim to the Oil Spill Liability Trust Fund (OSLTF) is approved. The Trustees must request the contingency funds from the NPFC, if needed. If approved, the contingency funds would then be released to the Trustees. Inclusion of contingency costs is common engineering practice and is not limited to natural resource damage assessment work. The contingency funds would be taken from the OSLTF, which is not funded through tax-payer dollars but rather through a tax 5-cent/barrel tax, collected from the oil industry on petroleum produced in, or imported to, the United States.

Comment 76: One person asked what project monitoring would entail, if monitoring costs were covered by the Responsible Party, and if an external party could participate in the monitoring efforts.
Response: Each restoration project will have a detailed monitoring plan developed during the final design phase. Each plan will address monitoring needs for each type of restoration project to be implemented. Vegetation biomass and species composition, presence/absence of fish species, and bird censuses are often conducted in these types of restoration projects. The costs are built into the overall project costs and will be included in the claim sent to the NPFC. After the monitoring plans are developed, the Trustees will determine and select qualified individuals to conduct the monitoring.

Use of Restored Habitats by Multiple Species

Comment 77: Two commenters expressed concern that selected preferred restoration projects were double-counting the injury, because each injury-specific project would provide benefits to multiple species or injuries. In particular, they noted concerns that oyster reef acreage for birds would compensate for injuries to subtidal habitat, that services provided by marsh creation projects for shoreline would overlap with services provided by marsh creation projects for dabbling ducks and related guilds, and that marsh creation for benefits to dabbling ducks would overlap with wetland creation benefits to swans and geese. One of these commenters stated that, for projects that benefit more than one species, the credit should be given for each resource benefitted.
Response: Trustee analyses account for multiple services provided by restored habitat and potential double-counting issues. Compensatory restoration (i.e., *Spartina* marsh and oyster reef) for injuries to non-herbivore biota is scaled based on the amount of food production (i.e., benthic macroinfauna) required to offset lost biomass (accounting for trophic transfer efficiencies), and therefore is additive. The vegetation from the above-referenced marsh restoration project cannot also be used to compensate for herbivore (geese and swan) injury, for at least two reasons: (1) Canada geese and swans do not consume grown *Spartina*; and (2) fencing is commonly undertaken to prevent herbivore consumption of recently established *Spartina* (which would prevent development of a functioning marsh habitat). Injuries to habitat (e.g., marsh, coarse substrate, sand/mud substrate and seawalls) represent an additional loss beyond injuries quantified for biota.

Therefore, additional habitat restoration is required to offset lost productivity from injured habitat, beyond the compensatory productivity required to offset the biomass of lost biota.

Restoration Projects for Bird Compensation

Comment 78: One commenter recognized the importance of protecting land and asked if there were properties identified by land trusts that might be obtained to increase the amount of acreage available for migrating bird species and other injured habitats.
Response: The full suite of projects proposed for the *Athos* restoration plan are in Tier 1 on pages 46-52 of the document. The list of restoration ideas and alternatives considered by the Trustees included projects requiring land acquisition and restoration for migratory bird species. There were ten projects proposed within Tier 1 that dealt with acquisition. Five of these projects proceeded from Tier 1 to Tier 2, but none were chosen as preferred alternatives in the Tier 2 scoring.

Comment 79: One commenter presented an analysis comparing the calculated value of individual waterfowl under the lost use injury assessment to a "cost per bird" value estimated from the restoration scaling conducted for the bird injury. Based on calculations, the commenter identified a consumptive value ("use value") of roughly $30 per individual for ducks or geese under hunting scenarios (based on per-trip value and estimated hunting success per trip), relative to a cost of $5,420 per individual for restoration projects (based on calculations of 2,103 direct mortalities to ducks or geese and $11.4 million in restoration projects). The commenter further stated that the consideration of non-use values would still not bring the value significantly higher than $30 per individual.

The commenter then asserted, based on the above calculations, that the Trustees' approach to valuation violates the "grossly disproportionate test" outlined in *Ohio v. Interior*[57] because the cost of the proposed restoration projects "exceeds by a considerable margin the value of the resource so created". The commenter also requested an evaluation of the Trustees' proposed restoration costs with respect to the "grossly disproportionate" and "cost-effectiveness" criteria.
Response: The calculations and comparisons made in this comment are flawed and inappropriate, for several reasons. First, under OPA regulations, the Trustees are obligated to evaluate all proposed alternatives. As part of this analysis, they are obligated to consider cost, among other factors, as outlined in the process described in the draft DARP (Section 5.2). Second, the Trustees' claim to the NPFC includes a demand for the lost value of hunting trips forgone or diminished in quality due to the spill, as well as the cost of restoration projects of a type and scale sufficient to offset the loss of birds due to the spill. The value hunters may derive from hunting activity is separate from and unrelated to the value the rest of society and the ecosystem derives directly and/or

[57] State of Ohio v. United States Department of the Interior, 880 F.2d 432, 441, 459 (D.C. Cir. 1989).

indirectly from the presence of birds. Comparison of a hunting-derived bird value to the cost of a restoration project intended to enhance all of the services provided by birds is inappropriate. Third, the commenter's exclusion of indirect bird losses in "per-bird" calculations of ecological restoration cost is without foundation and introduces bias into the calculations presented. Finally, the *Ohio v. Interior* (1989) did deal with restoration costs compared to the value of the resource. Industry's position in *Ohio* was that the CERCLA NRDA regulations (43 CFR 11) required a grossly disproportionate standard that would prevent trustees from selecting a restoration option if its costs were grossly disproportionate to the value of the injured resources. This issue was interpreted in a later challenge to the CERCLA regulations in *Kennecott v. DOI*,[58] in which the court stated "The argument is based on a misreading of *Ohio*. The court there held that restoration costs were the preferred measure of damages. …Interior's decision not to adopt a gross disproportionality rule is a permissible response to the *Ohio* decision."

Comment 80: One commenter asserted that the Trustees assume the diet of dabbling ducks (primarily mallards, teal, and black ducks) is exclusively invertebrate, but that the actual diet of dabbling ducks is primarily vegetation (citing the Birds of North America and the Chalk Point Oil Spill DARP). The commenter then noted that this may appear to be a minor issue, but that this assumption implies a large amount of restoration is necessary to offset the reduction in mallard services; whereas if dabbling ducks are assumed to be herbivorous, compensatory requirements would be estimated to be much less.

Response: In the Chalk Point spill, waterfowl were considered to be invertebrate-consuming bottom feeders (See: Section 5.5.5 of the Chalk Point DARP/EA and Appendix B of French McCay et al. 2002). For the Athos DARP, mallard ducks are chosen as the epresentative species for the dabbling duck guild, since the majority of the dabbling duck injury is to this species. As noted in Birds of North America, mallard ducks are an "[o]mnivorous and opportunistic, generalist feeder" and are "[v]ery flexible in food choice".[59] In the planned Spartina alterniflora community at Mad Horse Creek, wintering migrating waterfowl are expected to feed in large part on invertebrates that use Spartina as a food source (i.e., invertebrates that feed on detritus of decaying Spartina plant parts) and/or invertebrates that use living Spartina plants as food and/or cover (i.e., snails). While mallards are opportunistic feeders, their primary dietary strategy for this project is more reasonably categorized as invertebrate consumers rather than herbivores.

Comment 81: One commenter noted that the Trustees rely on a method referred to as trophic scaling to determine the size of the restoration projects to compensate for avian injuries. The commenter then stated that when estimating the compensatory requirements for dabbling ducks (classified by the Trustees to be invertivores) the Trustees' scaling

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[58] Kennecott Utah Copper Corporation v. United States Department of the Interior, 88 F3d 1191 (D.C. Cir. 1996).

[59] Drilling, Nancy, Rodger Titman and Frank Mckinney. 2002. Mallard (*Anas platyrhynchos*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/658

acknowledges that 105 kg of new invertivores are supported by the consumption of the newly created invertebrate biomass. The commenter asserted that the Trustees' scaling ignores the possibility that the newly created marsh produces vegetation sufficient to support 750 kg of herbivores, including geese, which would result in a large cost savings.
Response: It is inappropriate to rely on the specific calculations presented by the commenter, which reference a scaling document from the Chalk Point oil spill that provided preliminary estimates of the primary productivity of several marsh types. Primary productivity-based scaling options were not chosen for the final Chalk Point DARP/EA, and so were never fully developed and finalized. For example, the referenced scaling document assumes that below-ground biomass is part of "available" primary productivity, which was rejected in a later, published manuscript based in part on the scaling document (e.g., see French McCay and Rowe 2003, which states that 95% of belowground productivity is converted back to carbon dioxide and negligible quantities are available to other sources). All of the *Athos* scaling calculations undertaken by the Trustees assume that only aboveground biomass contributes to trophic transfer.

Compensatory marsh restoration for injuries to non-herbivore biota is scaled based on the amount of food production (i.e., benthic macroinfauna) required to offset lost biomass (accounting for trophic transfer efficiencies). The vegetation from the marsh restoration projects cannot also be used to compensate for herbivore (geese and swan) injury, for at least two reasons: (1) Canada geese and swans do not consume grown *Spartina*; and (2) fencing is commonly undertaken to prevent herbivore consumption of recently established *Spartina* (which would prevent development of a functioning marsh habitat).

Comment 82: Two commenters did not agree that creation of oyster reef beds will accomplish the restoration benefits stated in the draft DARP. Oyster bed creation was proposed to restore services to gulls, diving ducks, shorebirds, kingfishers, and wading birds.
Response: Oyster reef restoration projects produce a general increase in secondary productivity versus the existing non-vegetated bottom habitat, which is then introduced to the larger food chain. Placing shell and seeding oyster beds would directly enhance benthic habitat, with increased biomass generated by the seeded oysters and associated reef biota. In addition to oysters, reef-enhanced epifauna (e.g., mud crabs, grass shrimp, and other small crustaceans such as amphipods, tanaids, and isopods) are expected to be recruited to the reef. Productivity will be transferred to higher trophic levels (fish and then birds) through predation. A trophic scaling factor is included to acknowledge the multiple levels of transfer assumed. Shorebirds are not assumed to obtain benefits from the oyster reef projects; injuries to shorebirds are scaled to marsh restoration projects.

Comment 83: One commenter agreed diving ducks and cormorants will benefit from the oyster reef project, but failed to see benefits for shorebirds, kingfishers, gulls, and wading birds. The commenter stated that none of these species feed in subtidal areas, no benefits to tidal areas will be provided with the creation of subtidal oyster beds, and the assumed creation of fish resources is unrealistic. It is further asserted that benefits for cormorants, kingfishers, and wading birds are provided in the draft DARP/EA's wetland projects, but

the relatively small direct and indirect injuries to these groups do not warrant a large project such as the oyster reef restoration specifically for these species.
Response: Compensation for diving ducks, kingfishers, and wading birds constitute roughly one quarter of the biomass benefits from the oyster reef restoration project. The majority is for injuries to gulls. As noted in the response above, benefits of marsh restoration projects are calculated to benefit specific species through the combined primary and secondary productivity (the overall habitat of the marsh). Therefore, additional species cannot be subsumed into the scaling for these injuries.

Comment 84: One commenter preferred projects that protect horseshoe crab spawning areas, asserting that this would benefit gulls and shorebirds more than restoration of a subtidal oyster reef. The commenter specified that the following Tier 2 projects would provide the greatest benefit to gulls and shorebirds: Kelly Island Shorebird and Horseshoe Crab Project, Prime Hook National Wildlife Refuge (Horseshoe Crab/Avian Restoration), and Gandy's Beach Acquisition and Preservation. The commenter stated each of these projects appeared to fail based on questionable marks given in the selection criteria listed in Table 17. The commenter noted that the document "Factors to Evaluate Proposed Restoration Projects under the Oil Pollution Act Delaware River/M/T *Athos* Oil Spill" reads: **"**A restoration project that not only restores an injured resource but provides incidental benefits to other resources whether injured or not is generally preferable." The commenter observed that the Kelly Island Shorebird and Horseshoe Crab Project, and the Prime Hook NWR (Horseshoe Crab/Avian Restoration) projects would enhance services to gulls, other shorebirds, wading birds, and Red Knots, a candidate species in significant population decline. The commenter urged the Trustees to consider one or both of these projects, rather than the proposed oyster bed projects, asserting that the proposed alternative would not provide services for wading birds, gulls, or shorebirds.
Response: The projects endorsed by the commenter were thoroughly considered by the Trustees during the initial restoration planning phase, but were ultimately rejected because they were deemed infeasible at the time of proposal. The Trustees acknowledge that these projects may have provided a more direct link to services for wading birds and gulls. Shorebird injuries are addressed separately by marsh restoration projects.

Regarding the Horseshoe Crab Fishery Buyout project, there was insufficient information from the horseshoe crab industry on their willingness to participate, making implementation in a 12-month timeframe very unlikely. Similar issues arose with the Delaware Bay Shoreline Restoration Project and Misipillion Horseshoe Crab and Shorebird Project: Beach Improvements/Dune Stabilization - there was insufficient information on project locations and no planning and/or design completed; hence, the projects could not be evaluated under the OPA and NEPA criteria used for project selection. This process is outlined in the DARP's initial Tier 1 screening criteria that applied to all proposed projects. To be considered, a project must have: (1) the potential to result in a quantifiable increase in one or more of the injured resources (i.e., nexus to the injury); and (2) sufficient information about the project must be available to allow evaluation with the OPA and NEPA criteria to enable implementation within 12 months of the finalization of the Restoration Plan.

Comment 85: Two commenters noted that without long-term protection of the oyster reefs, oyster harvesting could reduce the beds to an inconsequential benefit. In addition, one commenter noted that enforcement of the 5-year harvest moratorium may be difficult to impose. This commenter also stated that salinity in the Bay will likely cause 100% mortality of oysters. Consequently, when this project went through the tiering process, the categories of project longevity and long-term operation and maintenance should have been reduced.
Response: The scaling process for the oyster reef benefits includes their expected harvesting and/or siltation (i.e., a half-life of roughly 5 years). Therefore project longevity and long-term operation and maintenance are appropriate to the project benefits. Marine enforcement units are notified of any closures in the Bay as part of the states' natural resource responsibilities and bed closures have been used as part of management strategies with good success.

No significant long-term shifts in salinity are being seen in the Bay. Disease is the single largest factor inhibiting shellfish production. Dermo, a protozoan parasite that moved in from southern waters, has an enormous influence on oyster population and abundance. Scientific emphasis has been placed on the relationship between salinity and the range of oyster disease, predators, and fouling organisms. Since the advent of the Dermo era (and to a lesser extent today, MSX, another oyster parasite), it has become clear that salinity is indeed a critical factor in the distribution and progression of these two oyster parasites, and that excessive oyster mortalities are closely linked to a paucity of fresh water inputs to the system. In the end, higher salinities will lead to an increase in disease epizootic events. This is not debatable. Monthly salinity monitoring in the Bay has shown the Middle oyster reef is tracking nicely along the 10-year mean. Since 2006, the 3-year mean of natural mortality for this reef ranges from 14-25% - and two of these years are under what are considered to be "epizootic events". This is the normal anticipated annual mortality. We have no reefs in the Bay (including industry leases in 25+ ppt salinity waters) where we would expect to see 100% mortalities under average conditions.

Comment 86: Two commenters noted that identifying the oyster reef restoration as a benefit to gulls, shorebirds, or wading birds will set an improper precedent for future oil spill restoration considerations. If the Trustees successfully argue and justify a subtidal oyster reef restoration project as a benefit to gulls and wading birds, this faulty logic will adversely influence future restoration decisions.
Response: Given the absence of more suitable projects, in this case creation of oyster reefs remains the best project available to compensate for the identified injuries. The Trustees disagree with commenter's assertion of faulty logic. As previously noted, oyster reef restoration projects produce a general increase in secondary productivity versus non-vegetated bottom, which is then introduced to the larger food chain. Placing shell and seeding oyster beds would directly enhance benthic habitat, with increased biomass generated by the seeded oysters and associated reef biota. In addition to oysters, reef-enhanced epifauna (e.g., mud crabs, grass shrimp, and other small crustaceans such as amphipods, tanaids, and isopods) are expected to be recruited to the reef. Productivity will be transferred to higher trophic levels (fish and then birds) through predation. A trophic scaling factor is included to acknowledge the multiple levels of transfer assumed.

The suggested alternatives mentioned in a comment above did not pass the tiering screening.

Comment 87: In reference to the Blackbird Reserve Project, one commenter expressed concern with creating agricultural food plots and planting cool season grasses, versus warm season grasses.
Response: The Blackbird Reserve restoration project aims to restore injured migratory Canada geese. Although warm season grasses are a beneficial and important wildlife habitat type, at this site, they are not appropriate restoration for migrating Canada geese. The proposed restoration project will have incidental benefits to other species of wildlife by providing habitat heterogeneity consisting of small areas of agricultural food plots and cool-season pastures within a much larger forest complex on a state wildlife area. The pastures will be planted with a mix of clover and fescues beneficial to most wildlife. Mowing of this habitat will be minimized to the extent and timing practical, while still maintaining suitable wintering habitat for migratory Canada geese.

Comment 88: Two commenters stated concern with the loss of agricultural land for restoration projects.
Response: The Blackbird Reserve project is being conducted on a state wildlife area. When this property was purchased, land use restrictions were applied to it through the funding process that required that all existing agricultural practices be discontinued in the near future and all agricultural areas be converted to other habitats. In order to maintain a diversity of habitats on the parcel, a variance from the original agreement was obtained which allows for a small portion of the property to remain in agricultural practice. Therefore, this restoration project will maintain 23.6 acres of agricultural land and increases habitat heterogeneity on this 535-acre property. Of these 23.6 acres, only 20 percent (4.7 acres) are being left unharvested as a standing crop for migratory geese. The remaining acreage will stay in active use for harvest by the contracted farmer. Therefore, this restoration proposal will yield a net increase in agricultural land not a decrease. The Mad Horse Creek project area was once tidal marsh before it was filled to create farmland. The filling degraded the marsh, allowing an invasion of *Phragmites* and altering the hydrology of the area. The restoration of Mad Horse Creek will restore the area to conditions similar to its original state before manipulation.

Comment 89: One commenter stated that there was a discrepancy between the proposed restoration costs and the value of the waterfowl resources. The commenter suggested a more cost-effective restoration option available to the Trustees may be to compensate for any reduction in the waterfowl population via a program that paid hunters to not harvest waterfowl. The commenter then suggested that such a program would be entirely analogous to the lobster compensation scheme developed in response to the North Cape oil spill in which lobster fishermen were paid to return lobsters that otherwise would have been harvested to the sea.
Response: The commenter mischaracterizes the North Cape lobster restoration project. That project paid lobstermen who participated in the capturing, v-notching, and returning of female lobsters to offshore waters to enhance egg production. Lobstermen were not paid to abstain from lobstering. A similar program is not possible with respect to bird

hunting. Although the Trustees do have the option of implementing additional restrictions on hunting in their respective jurisdictions if they determine that this action should be an appropriate means of restoration, this decision is one that would be made by the Trustees after considering public comment and evaluating and balancing all of the relevant factors involved. RPs are not authorized to unilaterally undertake any natural resource restoration.

In addition, part of the mission of the Trustee agencies is to promote and improve access to public lands for recreational use, including hunting. Paying hunters to not hunt is directly counter to that mission, and an unacceptable restoration approach.
Programs that pay commercial waterman are exactly that, compensation for reduction in effort for a commercial venture. Paying waterfowl hunters not to hunt would be entirely different as they do not hunt for commercial purposes but instead recreational.

Restoration Projects for Recreational Compensation

Comment 90: One commenter stated that the Augustine Boat Ramp should not be included in the final Plan because it is not within the spill zone and there may be other projects that would benefit passive recreation. The commenter also stated that if the boat ramp is used for homeland security purposes, other funding should be allocated to it. The commenter also opposes the placement of another jetty due to environmental impacts.
Response: The Augustine Boat Ramp restoration project is within the spill impact zone. Shoreline segments near it were very light to lightly oiled. This project was selected because of its importance to recreational boaters, anglers, and waterfowl hunters, as well as the need to address current shoaling conditions limiting these recreational activities. When considering this alternative, the Trustees were mindful of the results outlined in the *Athos* Lost Use recreational use surveys. This document indicated that New Castle County (Delaware) experienced the greatest loss in the number of recreational fishing and waterfowl hunting trips. The Augustine Boat Ramp project is intended to compensate for these lost and adversely affected recreational trips – as opposed to addressing homeland security issues. This proposal also went through the restoration evaluation criteria and was favorably scored in Tier 1 and 2. The environmental impacts associated with the proposed jetty will be thoroughly reviewed and mitigated for during the Federal 404 and State of Delaware Subaqueous Lands Permit process.

Comment 91: One commenter pointed out the large amount of trash that washes up onto Little Tinicum Island and stated that the project laid out in the DARP will encourage people and wildlife to be within 2000 feet of the end of the proposed CEP runway at Philadelphia International Airport, which may be in conflict with FAA Advisory Circular 150/5200-33B.
Response: Like many river islands, Little Tinicum Island receives frequent trash accumulation. There have been five successful cleanups since 2003 that have shown strong support from the community, state, and local governments, and local marinas. The Commonwealth of Pennsylvania will continue to support and organize regular clean up events for the island. This project is intended to provide recreational benefits. Habitat

improvement measures are limited to the removal of invasive plants. The Trustees do not anticipate any significant change in wildlife hazards to aviation compared to the existing conditions.

Comment 92: One commenter thought that a better recreational project on Little Tinicum Island would be a canoe trail through the wetlands. Improvement efforts along the existing trail could help eliminate travel in sensitive habitats and interpretive signs could be used to direct people out of these sensitive habitats by explaining the habitat and its value. The commenter also expressed concern about trash problems in the area and recommended a floating trash collector be put in place.
Response: A low impact canoe trail and a floating trash collector were not proposed during the restoration planning process which involved a public request for project proposals. The Commonwealth of Pennsylvania plans to continue to organize and conduct volunteer trash clean up events at the site.

Comment 93: One person commented that passive recreation projects should be investigated for inclusion in the DARP.
Response: The Trustees believe many of the ecological restoration and recreational projects would result in collateral benefits to other recreational uses such as hiking, photography or nature studies, kayak/canoe usage, and bird watching.

Comment 94: One comment did not support the Stow Creek Boat Ramp as it appears it would exacerbate a problem of too much boat traffic and disturbance near a long-term bald eagle nest.
Response: The comment is noted. The U.S. Fish and Wildlife Service noted that bald eagles may forage in the area, but no nests are known to be present in the project impact area. Therefore, due to the limited timeframe for implementation of the project and limited usage by the bald eagle, there will be little if any disturbance to the bald eagle. The Trustees will continue consultation with the U.S. Fish and Wildlife Service during final design and implementation to ensure compliance with any Federal and State laws.

Comment 95: One commenter supported keeping the Stow Creek Boat Ramp as is for more passive recreational uses as a canoe and kayak launch.
Response: The Stow Creek Boat Ramp project has been selected to compensate for injuries to recreational boaters, which were found to be significantly impacted in the damage assessment process. Other recreational uses, such as kayaking, bird watching, etc., were not found to be significantly impacted as a result of the spill. However, the launch will not be restricted to motorized recreational boaters and will continue to be available for use by kayakers and other paddlers. In addition, the improvements should enhance the safety of all users of the ramp.

Restoration Projects for Shoreline Compensation

Comment 96: One commenter noted that the Trustees state that *Phragmites* dominated marshes provide a service level similar to wild rice and *Spartina* marshes and that this assumption was used in determining injury to oiled *Phragmites* marshes. Therefore, compensatory restoration projects designed to convert *Phragmites* marshes to *Spartina* marshes provide little to no increase in services and should be rejected in the restoration screening process. However, the commenter then noted that when justifying restoration projects, the Trustees state that a degraded *Phragmites* marsh provides 10% of the services of a healthy *Spartina* marsh. In this case, the assumed service reduction associated with impacted *Phragmites* marshes should be adjusted to incorporate the relatively low level of services they were producing under baseline conditions.
Response: Hydrologic connectivity is the primary driving factor for the benefits accrued from marsh restoration projects. Approximately 7% of the injured area on the mainstem of the Delaware River consisted of fringing marsh habitat.[60] By definition, only marsh areas with hydrologic connectivity were exposed to spilled oil. To the extent *Phragmites* is present in these areas, the marsh is still likely to be well-functioning due to the hydrologic connectivity. The extent of marsh coverage, and the focus on fringing marshes, is shown in the Environmental Sensitivity Index maps, which are Appendix D to the Shoreline Injury Assessment report, available upon request. Injury to marsh habitat is a minor portion of the injury associated with shoreline areas. The majority of such injury occurred in tidal flat areas (75% of acreage). For these reasons, the impact of the potential presence of *Phragmites* in injured marsh habitat on injury calculations is negligible.

With respect to restoration, as noted in Section 5.2 of the DARP, projects that were solely *Phragmites* removal were rejected. The projects selected in the DARP are focused on restoring hydrologic connectivity (and thus creating tidal wetlands) to compensate for injuries to shoreline habitat. The statement that the severely degraded, interior area of a former marsh at the proposed Mad Horse Creek restoration site provides 10 percent of the services of a healthy *Spartina* marsh reasonably reflects the very limited hydrologic connectivity of this area and its limited accessibility to aquatic biota (the former marsh area has been significantly degraded due to the addition of fill material as well as the characteristic of *Phragmites*-dominated marshes to rapidly accrete). The remaining, tidally connected portions of the Mad Horse Creek site, closer to the Delaware River, are not part of the restoration project.

Comment 97: One commenter expressed concern about importing fill material to the Lardner's Point restoration project, as well as the large pier visible on the site design. The commenter wanted to review plans for this project and encouraged the use of native plants.
Response: The existing shoreline in the project area consists of concrete rubble fill, which will be removed. Clean sandy material will be emplaced to create a more natural

[60] See Section 2.3 in the Shoreline Injury Assessment report on determining shoreline habitat types.

shoreline and as a substrate for planting native plants along with the reconstructed shoreline. The large concrete pier on the conceptual drawings is an existing structure, and will remain on the site. The plans for this restoration project will continue to undergo thorough oversight and review by the Trustees as this project progresses. If there are significant changes to the project plan, these changes will be made available for public review and comment. This shoreline restoration project is intended to compensate for shoreline injuries, and is the only portion of Lardner's Point park project associated with the *Athos* natural resource restoration. The remainder of the park project is funded through other sources.

Comment 98: One commenter stated that OSLTF funds should not be used to fund previously identified infrastructure projects, in particular dam and obstruction removals on Darby Creek that may have already been planned due to obsolescence or other factors. The commenter also stated that since a fish kill was not associated with the *Athos* spill, there is no justification for the dam removals.
Response: The Trustees determined that approximately 1,899 acres of tributary habitat - shorelines, extensive wetlands, intertidal flats, and shallow benthic habitats – were injured by the *Athos* oil spill. To compensate for this loss, the Trustees proposed removal of three dams and a remnant bridge pier from Darby Creek in southeastern Pennsylvania, followed by restoration of the in-stream areas. American Rivers, a non-governmental organization, has taken the lead in organizing and overseeing this project and sent it forward during the restoration planning request for projects. These removals are compensating for injuries to tributaries, not injuries to fish, and to the Trustees' knowledge have no funding commitments. The removal of these dams and associated habitat restoration, including restoration of shallow benthic habitat, is suitable for compensation of this injury.

Comment 99: One commenter stated that the Mad Horse Creek and John Heinz National Wildlife Refuge projects pose concerns due to dredged spoils that are likely heavily contaminated with PAHs and heavy metals. The commenter stated that there was no consideration given to the impact of moving these materials, and because of this, costs for these projects will be significantly higher than estimated.
Response: Thirty sediment samples were collected from the Mad Horse Creek project area and analyzed for arsenic, lead and a CLP pesticide scan. The results of sampling analysis showed there was no concern for ecological risk at this site. Initial contaminants analysis of the spoil at John Heinz National Wildlife Refuge was conducted to determine if the material would require hazardous waste disposal. Six surface samples were collected and analyzed for inorganic (e.g., metals) and organic (e.g., petroleum products, PCBs, and pesticides) chemicals. Only one sample exceeded a benchmark, however, the average total PCB concentration was below 1 ppm. PCB exceedances are typically found in this urban watershed and a fish advisory is in place. In the 1990s, adjacent areas were restored to tidal wetlands. The Blue Route Mitigation Site (1992) and the Airport Mitigation Site (1996) have already been completed in this area. This 56-acre area in the Refuge is the remaining area that has not been restored. Further contaminants testing will occur as the project moves forward.

Public Comment Process

Comment 100: One commenter stated that the Trustees' denial of an extension of the public comment period for the draft DARP/EA hindered review of the document. This commenter requested an additional 60 days to review more closely the restoration project screening, scaling, and selection process in the underlying draft DARP/EA.
Response: The Trustees recognized that such a complex draft DARP/EA might take longer to review than other such documents. The OPA NRDA regulations require a minimum of 30 days for public review and comment on draft DARP/EAs (*See*, 15 CFR 990.23(c)(1)(ii)(D)). The Trustees believed that extra time would be needed on this case because of the complexity of the *Athos* plan. Therefore, the Trustees chose a 45-day comment period, rather than the required 30-day period. The Trustees did not extend the comment period because delay might have prevented any field work in 2009. Also, some of the preferred projects may have been no longer available had the Trustees extended the comment period.

Comment 101: Several commenters asked that the Trustees respond to the comments received with a written explanation and that these responses be included in the Administrative Record.
Response: All comments received, and the Trustees' responses to these comments, will be included in the final Restoration Plan. They are available in the Administrative Record and have been posted on the web at:
http://www.darrp.noaa.gov/northeast/athos/admin.html

Comment 102: One commenter requested that the Trustees extend the comment period on the draft DARP/EA for another 45 days if there are any revisions made in the document as a result of the public review.
Response: If significant revisions to the draft DARP/EA are made in response to comments received, those revisions will made available for review and comment for at least 30 days.

Appendix 2. File structure and index of the Administrative Record developed by the Trustees for the *Athos* oil spill

1. BACKGROUND INFORMATION
   - 1.1. OPA
   - 1.2. OPA NRDA Regulations
   - 1.3. State laws

2. COORDINATION
   - 2.1 Among Trustees
     - 2.1.1 Final MOA among NOAA, DOI, States of Delaware and New Jersey and Commonwealth of Pennsylvania regarding NRDA Restoration and Activities Arising from Athos 1 Spill in the Delaware River, April 11, 2005

   - 2.2 With Response
     - 2.2.1 USCG Investigation into the Striking of Submerged Objects by the Tank Vessel Athos 1 in the Delaware River of January 19, 2006
     - 2.2.2 USCG Press Release, Document Number: 88, Delaware River Oil Spill Update #21 and Third Party Claims Process for Athos 1 Oil Spill Claims Changing, February 16, 2005
     - 2.2.3 USCG National Strike Force Coordination Center Preparedness Department,
       T/S Athos 1 Evaluation Report of August 25, 2005
     - 2.2.4 NPFCPOLICY CN05, NRD Contingency Payments, National Pollution Funds Center, USCG, January 24, 2007

   - 2.3 With Responsible Parties
     - 2.3.1 Sharon K. Shutler letter to Gene O'Connor and Tim Bergere regarding NRDA upfront funding of January 7, 2005
     - 2.3.2 Timothy J. Bergere letter to Sharon Shutler, Robert Kuehl, Marcia Gittes, and Joan Olawski-Steiner regarding funding for joint preassessment/assessment activities of January 14, 2005
     - 2.3.3 Sharon K. Shutler letter to Gene O'Connor and Tim Bergere regarding an invitation to participate in a damage assessment of March 9, 2005
     - 2.3.4 Timothy J. Bergere letter to Sharon Shutler accepting the invitation to participate in NRDA of May 24, 2005
     - 2.3.5 Sharon K. Shutler letter to Gene O'Connor and Tim Bergere regarding their acceptance to participate in NRDA of June 21, 2005

   - 2.4 With Public
     - 2.4.1 Office of Response and Restoration article on M/T Athos 1 Delaware River Oil Spill of November 2005
     - 2.4.2 Scoping letter sent to public soliciting ideas; sent on December 16, 2005 by Athos 1 lead administrative trustee

2.4.3 Attachments to scoping letter sent to public soliciting ideas; sent on December 16, 2005 by Athos 1 lead administrative trustee
2.4.4 List of people receiving the scoping letter sent to public soliciting ideas; sent on December 16, 2005 by Athos 1 lead administrative trustee
2.4.5 Copies of scoping letter sent to public soliciting ideas; sent on December 16, 2005 by Athos 1 lead administrative trustee
2.4.6 Response to scoping letter of December 16, 2005 from Maya K. van Rossum, the Delaware Riverkeeper of January 18, 2006
2.4.7 Responses to scoping letter of December 16, 2005 from Tom Witmer – not dated
2.4.8 Responses to scoping letter of December 16, 2005 from Andrew T. Manus, The Nature Conservancy – not dated
2.4.9 Responses to scoping letter of December 16, 2005 from Kathy Klein, Partnership for the Delaware Estuary, Inc. of January 10, 2006
2.4.10 Responses to scoping letter of December 16, 2005 from Nicholas A. DiPasquale, Delaware Audubon Society of January 12, 2006
2.4.11 Department of Commerce Federal Register Notice of Intent to Conduct Restoration Planning of Monday, July 3, 2006 (Vol. 71, No. 127)
2.4.12 Office of Response and Restoration article on M/T Athos 1 Delaware River Oil Spill of October 2006
2.4.13 T/V Athos 1 Delaware River Oil Spill, NOAA Fact Sheet of January 2005
2.4.14 Office of Response and Restoration article on M/T Athos 1 Delaware River Oil Spill Restoration of December 2008
2.4.15 Department of Commerce Federal Register Notice of Availability and Restoration Plan and Environmental Assessment for the M/V Athos 1 Oil Spill; Request for Comments of January 6, 2009 (Vol. 74, No.3)
2.4.16 Request for copy of Draft Damage Assessment and Restoration Plan and Environmental Assessment from Paul Friesema of January 6, 2009
2.4.17 Public comments on Federal Register Notice of Draft Damage and Restoration Plan and Environmental Assessment from B. Sachau of January 6, 2009
2.4.18 Public comments on Federal Register Notice of Draft Damage and Restoration Plan and Environmental Assessment from Laurie Strong of January 8, 2009
2.4.19 Public comments on Federal Register Notice of Draft Damage and Restoration Plan and Environmental Assessment from Lillian Ballard of January 11, 2009
2.4.20 Public comments on Federal Register Notice of Draft Damage and Restoration Plan and Environmental Assessment from Pennsylvania Rep. Allyson Schwartz
of January 22, 2009
2.4.21 Public comments on Federal Register Notice of Draft Damage and Restoration Plan and Environmental Assessment from Borough of Lansdowne, PA, Craig Totaro of February 11, 2009
2.4.22 Public comments on Federal Register Notice of Draft Damage and Restoration Plan and Environmental Assessment from American Rivers,

Sara Strassman of February 11, 2009

2.4.23 Public comments on Federal Register Notice of Draft Damage and Restoration Plan and Environmental Assessment from Delaware County Planning Department, John E. Pickett of February 17, 2009

2.4.24 Public comments on Federal Register Notice of Draft Damage and Restoration Plan and Environmental Assessment from CITGO Petroleum Corporation of February 17, 2009

2.4.25 Public comments on Federal Register Notice of Draft Damage and Restoration Plan and Environmental Assessment from Frescati Shipping Company Ltd., and Tsakos Shipping & Trading S.A., of February 20, 2009

2.4.26 Public comments on Federal Register Notice of Draft Damage and Restoration Plan and Environmental Assessment from American Bird Conservancy, Michael Fry of February 20, 2009

2.4.27 Public comments on Federal Register Notice of Draft Damage and Restoration Plan and Environmental Assessment from ENTRIX, Inc., Ralph Markarian of February 20, 2009

2.4.28 Public comments on Federal Register Notice of Draft Damage and Restoration Plan and Environmental Assessment from Delaware Riverkeeper Network, Maya K. van Rossum and Faith Zerbe of February 19, 2009

2.4.29 Public comments on Federal Register Notice of Draft Damage and Restoration Plan and Environmental Assessment from Michelle Jonovic of February 20, 2009

2.4.30 Public comments on Federal Register Notice of Draft Damage and Restoration Plan and Environmental Assessment from Delaware County Conservation District, Edward Margargee of February 20, 2009

2.4.31 Public comments on Federal Register Notice of Draft Damage and Restoration Plan and Environmental Assessment from ITOPF Ltd. of February 20, 2009

2.4.32 Public comments on Federal Register Notice of Draft Damage and Restoration Plan and Environmental Assessment from Evergreen Environmental, LLC, Mark Renna of February 22, 2009

2.4.33 Public comments on Federal Register Notice of Draft Damage and Restoration Plan and Environmental Assessment from Fairmount Park, Mark Focht and Delaware River City Corporation, Sarah Thorp of February 20, 2009

2.4.34 Athos Trustee Presentation to Delaware Riverkeeper Network of February 13, 2009

2.4.35 Sign-in sheet for Athos Trustee Presentation to Delaware Riverkeeper Network of February 13, 2009

2.4.36 Draft Damage Assessment and Restoration Plan and Environmental Assessment, NOAA, DOI, States of Delaware and New Jersey and Commonwealth of Pennsylvania of January 2009

3. PREASSESSMENT PHASE
   - 3.1 Map of approximate location of the Athos Oil Spill in the Delaware River
   - 3.2 Final Preassessment Data Report M/T Athos 1 Oil Spill, Delaware River of June 2006
   - 3.3 Athos 1 Chemistry Data; Index
   - 3.4 The Scientific Characterization of the Delaware Estuary, The Delaware Estuary Program, Sutton, Herron, and Zappalorti, April 1996
   - 3.5 Commercial Fishing in Delaware 2000, Whitmore and Cole, not dated
   - 3.6 Technical Basis for Narcotic Chemicals and Polycyclic Aromatic Hydrocarbon Criteria. I. Water and Tissue, DiToro, McGrath and Hansen, December 13, 1999
   - 3.7 Ecological Risk Assessment of Polycyclic Aromatic Hydrocarbons in Sediments: Identifying Sources and Ecological Hazard, Neff, Stout and Gunster, June 23, 2005
   - 3.8 Toxicological Benchmarks for Wildlife: 1996 Revision, Sample, Opresko, Suter II, Date Issued – June 1996

4. RESTORATION PLANNING: INJURY ASSESSMENT
   - 4.1. General
     - 4.1.1 Discounting and the Treatment of Uncertainty in Natural Resource Damage Assessment Technical Paper 99-1, NOAA, February 19, 1999
     - 4.1.2 Magnitude and Extent of Contaminated Sediment and Toxicity in Delaware Bay, NOAA Technical Memorandum NOS NCCOS CCMA 148, June 2001
   - 4.2. Shoreline
     - 4.2.1 Final Report Shoreline Injury Assessment M/T Athos 1 Oil Spill, Prepared by Shoreline Assessment Team, 21 March 2007
     - 4.2.2 Response to RP Comments on Draft Shoreline Injury Assessment, Dr. Jim Hoff, January 27, 2006
     - 4.2.3 The University of North Carolina at Chapel Hill, Shoreline and Aquatic Peer Review Comments, Dr. Charles H. Peterson, October 31, 2006
   - 4.3. Aquatic Resources
     - 4.3.1 Final Report, Aquatic Injury Assessment, M/T Athos 1 Oil Spill, Delaware River System, Aquatic Technical Working Group, June 27, 2007
     - 4.3.2 The University of North Carolina at Chapel Hill, Shoreline and Aquatic Peer Review Comments, Dr. Charles H. Peterson, October 31, 2006 (see 4.2.3)
     - 4.3.3 RP Comments on the Draft Aquatic Injury Report, Polaris Applied Sciences, June 8, 2006
     - 4.3.4 Trustee Responses to RP Polaris Applied Sciences Comments on Draft Aquatic Injury Report, 2006

4.3.5 Results of Toxicity Testing with Leptocheirus pumulosus on Sediment Samples from the Delaware River, EA Engineering, January 27, 2005
4.3.6 Results of Toxicity Testing with Leptocheirus pumulosus on 15 December 2005 Sediment Samples from the Delaware River, EA Engineering, March 4, 2005
4.3.7 Results of Toxicity Testing with Leptocheirus pumulosus on 17 February 2005 Sediment Samples from the Delaware River, EA Engineering, April 26, 2005

4.4. Birds and Wildlife
4.4.1 Final Report Bird and Wildlife Injury Assessment M/T Athos 1 Oil Spill, Delaware River System, Prepared by Bird and Wildlife Technical Working Group, 22 June 2007
4.4.2 General Comments on Final Draft Bird & Wildlife Injury Assessment: M/T Athos 1 Oil Spill, Delaware River System, Polaris – Greg Challenger and Gary Mauseth, April 12, 2006
4.4.3 Athos Oil Spill Comments on Bird & Wildlife Injury Assessment, Michael Fry, December 21, 2006
4.4.4 Trustee Responses to Polaris April 12, 2006 Comments on the Draft Final Bird & Wildlife Injury Assessment Report, Jim Hoff, June 20, 2006
4.4.5 Mallard (*Anas platyrhynchos*), The Birds of North America Online, Drilling, N., R. Titman, and F. Mckinney, 2002
4.4.6 Estimating the Mortality of Seabirds Following Oil Spills: Effects of Spill Volume. Marine Pollution Bulletin. 26(3): 140-143, Burger, A.E., 1993
4.4.7 NRDAM/CME Version 2.51 Model, Databases & Technical Documentation CD, U.S. Department of Interior, Feb 2000

4.5. Lost Interim Use
4.5.1 Athos/Delaware River Lost Use TWG, Athos/Delaware River Lost Use Valuation, March 29, 2007
4.5.2 Benefit Transfer of Outdoor Recreation Use Values, Rosenberger & Loomis, 2001
4.5.3 Comments of the Responsible Party to the March 9, 2006 Athos 1/Delaware River Lost Use Valuation Report, unsigned, April 7, 2006
4.5.4 Comments of the Lost Use Valuation Study, Dr. George Parsons, April 16, 2007
4.5.5 Trustee Response to Comments of the Responsible Party Lost Use Valuation Report, National Oceanic & Atmospheric Administration, October 10, 2006
4.5.6 Valuation of Lost and Substitute Trips for the Athos 1 Assessment, Eric English, March 19, 2007
4.5.7 Response to Review of Dr. George Parsons Regarding the Athos/Delaware River Lost Use Valuation Report, Eric English, April 17, 2007

4.5.8 Comments on "Comments of the Responsible Party to the March, 9, 2006 Athos 1/Delaware River Lost Use Valuation Report", George R. Parsons, May 9, 2007

4.5.9 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, U.S. Fish & Wildlife Service

5. RESTORATION PLANNING: RESTORATION SELECTION

5.1. General

5.1.1 The Scientific Characterization of the Delaware Estuary, The Delaware Estuary Program, Sutton, Herron, and Zappalorti, April 1996 (see 3.4)

5.1.2 Commercial Fishing in Delaware 2000, Whitmore and Cole, not dated (see 3.5)

5.1.3 Factors to Evaluate Proposed Restoration Projects under the Oil Pollution Act, Delaware River/M/T Athos 1 Oil Spill, Athos Trustee Council, 2006

5.2. Shoreline

5.2.1 Discounting and the Treatment of Uncertainty in Natural Resource Damage Assessment Technical Paper 99-1, NOAA, February 19, 1999 (see 4.1.1)

5.2.2 Lower Darby Creek Area, Darby Township, PA, EPA Facility ID: PASFN0305521

5.2.3 Impact of Dam Removal on Fish and Macroinvertebrate Populations: Pennsylvania's Observations Power Point Presentation, Pennsylvania Fish & Boat Commission, R. Scott Carney, 2007

5.2.4 Final Damage Assessment/Restoration Plan and Environmental Assessment M/V Westchester Crude Oil Discharge, LOSCO et.al, December 21, 2001

5.2.5 Habitat Restoration as Mitigation for Lost Production at Multiple Trophic Levels, French McCay and Rowe, December 15, 2003

5.2.6 A Guide to the Natural Communities of the Delaware Estuary, NatureServe,
June 2006

5.2.7 Restoration Scaling of Benthic, Aquatic and Bird Injuries to Oyster Reef and Marsh Restoration Projects, McCay, Peterson & Donlan, April 16, 2002

5.2.8 Final Restoration Plan and Environmental Assessment for the April 7, 2000 Oil Spill at Chalk Point on the Patuxtent River, Maryland, NOAA et.al,
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5.2.9 The Ecology of Intertidal Oyster Reefs of the South Atlantic Coast: A Community Profile, Fish & Wildlife Service, DOI, May 1981

5.2.10 Map Index and General Spring Tide Zones, M/T Athos 1 Oil Spill, July 17, 2005

5.2.11 Methodology and Data Supplemental Material for use with the M/T Athos 1 Oil Spill: Shoreline Injury Assessment (CD with referenced data files included)
5.2.12 Shoreline Documentation Data – Table 3 – Length in Miles of Shoreline Habitat by Oiling Degree
5.2.13 Shoreline Documentation Data – Table 4 – Number of Acres Impacted by Oil From the Six Tributary Creeks in New Jersey
5.2.14 Shoreline Documentation Data – Table 5 – Total Estimated Area (Acres) of Exposed Habitat Across All States
5.2.15 Stream Ecosystem Response to Small Dam Removal: Lessons from the Heartland, Doyle, Stanley, Orr, Selle, Sethi and Harbor, April 14, 2005
5.2.16 Dam Removal: Challenges and Opportunities for Ecological Research and River Restoration, Hart et.al., August 2002
5.2.17 Changes in the Habitat and Fish Community of the Milwaukee River, Wisconsin, Following Removal of the Woolen Mills Dam, Kanehl, Lyons and Nelson, 1997
5.2.18 Estuarine Habitat Productivity Ratios at Multiple Trophic Levels, Peterson et.al., In preparation
5.2.19 Potential Responses of Riparian Vegetation to Dam Removal. Shafroth et.al., August 2002
5.2.20 Environmental Assessment – Determining Ecological Equivalence in Service-to-Service Scaling of Salt Marsh Restoration, Strange et.al., 2002
5.2.21 Restoration Scaling Paper for Injuries to Non-Tributary Shorelines: Salt Marsh Restoration at Mad Horse Creek and Habitat Creation and Restoration at Lardner's Point, Pennsylvania, Shellenbarger Jones & Donlan, April 22, 2008
5.2.22 Restoration Scaling Paper for Tributary Injuries: Dam Removal and Riparian/In-stream Habitat Restoration on Darby Creek and Habitat Restoration at John Heinz National Wildlife Restoration, Shellenbarger Jones & Donlan, April 17, 2008

5.3. Aquatic Resources
5.3.1 Restoration Scaling of Benthic, Aquatic and Bird Injuries to Oyster Reef and Marsh Restoration Projects, McCay, Peterson & Donlan, April 16, 2002 (see 5.2.7)
5.3.2 Oyster Workshop Power Point Presentation, Delaware Division Fish & Wildlife, March 8, 2007
5.3.3 Report of the 2007 Stock Assessment Workshop (9^{th} SAW) for the New Jersey Delaware Bay Oyster Beds, Haskin Shellfish Research Laboratory, Rutgers, February 5-6, 2007
5.3.4 2005 Shell-Planting Program in Delaware River, Report to the U.S. Army Corps of Engineers, Eric Powell for the Oyster Group, not dated
5.3.5 Final Report of Survey of Benthos: Delaware Estuary: From the Area of the C&D Canal through Philadelphia to Trenton, Environmental Consulting Services, Inc., December 15, 1993

5.3.6 White Paper on the Status and Needs of Science in the Delaware Estuary, Kreeger et.al, January 25, 2006
5.3.7 Progress in Oceanography, Metazoan Meiobenthos along Continental Margins: A Review, Soltwedel, May 11, 2000
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5.4.1 Restoration Scaling of Benthic, Aquatic and Bird Injuries to Oyster Reef and Marsh Restoration Projects, McCay, Peterson & Donlan, April 16, 2002 (see 5.2.7)
5.4.2 The Ecology of Intertidal Oyster Reefs of the South Atlantic Coast: A Community Profile, Fish & Wildlife Service, DOI, May 1981 (see 5.2.9)
5.4.3 Final Restoration Plan and Environmental Assessment for the April 7, 2000 Oil Spill at Chalk Point on the Patuxtent River, Maryland, NOAA et.al,, November 2002 (see 5.2.8)
5.4.4 Mitigation Project Monitoring Reports for Tidal Wetland, Checklist for Completeness, New Jersey Department of Environmental Protection, (8/00)
5.4.5 Nutrient Limitation Along a Productivity Gradient in Wet Meadows, Venterink, van der Vliet and Wasson, April 23, 2001
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5.4.7 Habitat Restoration as Mitigation for Lost Production at Multiple Trophic Levels, French McCay and Rowe, December 15, 2003 (see 5.2.5)
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5.4.12 Range, Wildlife and Fisheries Management, Management of Waste Corn for Waterfowl, Wintering on the Texas High Plains, Baldassarre and Bolen, Department of Range, Wildlife and Fisheries Management, Texas Tech University, not dated
5.4.13 Seasonal Abundance of Waste Corn and Soybeans in Illinois, The Journal of Wildlife Management, Vol. 53, No. 1 (Jan., 1989), pp.142-148
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5.4.17 UC SAREP Cover Crop Resource Page, University of California Sustainable Agriculture Research & Education Program, not dated
5.4.18 New Castle County, Delaware, Corn for Grain, 2003-2007, U.S. Department of Agriculture National Agricultural Statistics Service
5.4.19 Wetlands, (1st ed.), Mitsch and Gosselink, 1986

5.5. Lost Interim
5.5.1 Augustine Beach Breakwater Shoaling Study, Andrews, Miller & Associates, Inc., November 1989
5.5.2 Little Tinicum Island Trail and Habitat Enhancement Draft Proposal, Pennsylvania Department of Conservation and Natural Resources, January 19, 2006
5.5.3 New Castle County, Prioritized Areas Requiring Attention, New Castle, DE, March 2006
5.5.4 Priority Restoration Site Information, New Jersey Department of Environmental Protection, August 2006
5.5.5 The Diadem Trail on Little Tinicum Island in the Delaware River, Pennsylvania Department of Conservation and Natural Resources, not dated
5.5.6 Little Tinicum Island Map, not dated

6. RESTORATON PLANNING: RESTORATION PLAN

Appendix 3. Compliance with key Federal statutes, regulations, and policies

Oil Pollution Act of 1990 (OPA), 33 U.S.C. §§2701, et seq., 15 C.F.R. Part 990

OPA establishes a liability regime for oil spills that injure or are likely to injure natural resources and/or the services that those resources provide to the ecosystem or humans. OPA provides a framework for conducting sound natural resource damage assessments that achieve restoration. The process emphasizes both public involvement and participation by the Responsible Party (RP). The draft DARP/EA sought input from both the public and the responsible parties. The Trustees have conducted this assessment in accordance with OPA regulations.

Compliance: This Final Restoration Plan/Environmental Assessment is in compliance with the Oil Pollution Act of 1990 (OPA). The Trustees,have completed review of comments received on the draft DARP/EA, made appropriate revisions based upon those comments, selected the preferred restoration projects, and completed this Final Plan.

National Environmental Policy Act (NEPA), 42 U.S.C. §§4321, et seq., 40 C.F.R. Parts 1500-1508

The National Environmental Policy Act (NEPA) (42 U.S.C 4321 et seq.) requires Federal agencies to assess the effects of major Federal actions upon the human environment in the form of an environmental impact statement or EA. This EA is prepared in accordance with NEPA and its implementing regulations (40 CFR 1500-1508) and with the NEPA procedures established by the trustee federal agencies. The analysis describes the level of significance of the impacts expected to result from the proposed Federal action.

Compliance: Full compliance is achieved at the issuance of a Finding of No Significant Impact (FONSI).

Clean Water Act (CWA), 33 U.S.C. §§1251, et seq.

The CWA is the principal law governing pollution control and water quality of the nation's waterways. Section 404 of the law authorizes a permit program for the beneficial uses of dredged or fill material in navigable waters. The U.S. Army Corps of Engineers (USACE) administers the program. In general, restoration projects, which move significant amounts of material into or out of waters or wetlands—for example, hydrologic restoration or creation of tidal marshes—require 404 permits. Under section 401 of the CWA, restoration projects that involve discharge or fill to wetlands or navigable waters must obtain certification of compliance with state water quality standards. The application process to obtain these permits will be initiated and issuance of the required permits is expected at the completion of the process.

Compliance: 1.) The necessary state permits will be applied for by the New Jersey Office of Natural Resource Restoration (within NJDEP), the Delaware Department of Natural Resources and Environmental Control (DNREC), the Pennsylvania Fish and Boat Commission (PAFBC), the Pennsylvania Department of Environmental Protection (PADEP), and USFWS. 2.) Coordination with the Army Corps of Engineers will also be completed pursuant to Section 401 of the Clean Water Act. 3.) A 401 Water Quality Certification Review was will be undertaken by the Army Corps of Engineers. Coordination with the Army Corps will be completed pursuant to Section 401 of the Clean Water Act.

Clean Air Act, as amended, 42 USC 7401 et seq.
The fundamental goal of the Clean Air Act (CAA) is the nationwide attainment and maintenance of National Ambient Air Quality Standards (NAAQS). The Act uses two types of regulatory controls to affect two types of pollutant sources: Health-based standards represent "safe" levels of pollutants in the ambient air; technology-based standards represent the amount of a pollutant reduction within an industry's economic and technological capabilities. The CAA requires the Environmental Protection Agency (EPA) to establish primary and secondary NAAQS. Primary NAAQS are designed to protect human health. Secondary NAAQS are designed to protect the public welfare (e.g., to prevent damage to soils, crops, vegetation, water, visibility and property). The Clean Air Act requires permitting and reporting requirements for sources of air pollutants. Also, EPA reviews the discussion of CAA impacts for environmental impact statement (EIS) documents.

Compliance: Since the review and analysis of the draft DARP/EA did not result in the need to develop an EIS, compliance with the Clean Air Act is met.

National Historic Preservation Act, 16 U.S.C. § 470 et seq.
Section 106 of the NHPA requires federal agencies, or federally funded entities, to consider the impacts of their projects on historic properties. The NHPA regulations require that federal agencies take the lead in this process, and outline procedures to allow the Advisory Council on Historic Preservation to comment on any proposed federal action.

Compliance: A Section 106 consultation has been initiated on each project in Delaware, Pennsylvania, and New Jersey. Section 106 Consultations will be completed prior to project implementation after completion of final design plans and assessment of potential impacts can be determined. No impacts to historical sites, buildings, objects and/or antiquities of national significance are anticipated at this time.

Rivers and Harbors Act, 33 U.S.C. §§401, et seq.
The Rivers and Harbors Act regulates development and use of the nation's navigable waterways. Section 10 of the Act prohibits unauthorized obstruction or alteration of navigable waters and vests the USACE with authority to regulate discharges of fill and other materials into such waters. Restoration actions that comply with the substantive requirements of Section 404 of the CWA will also comply with the substantive requirements of Section 10 of the Rivers and Harbors Act.

Compliance: All projects will apply for Clean Water Act (Section 404) and Rivers and Harbors Act of 1899 permits.

Coastal Zone Management Act (CZMA), 16 U.S.C. §§1451, et seq., 15 C.F.R. 923
The goal of the CZMA is to preserve, protect, develop and, where possible, restore and enhance the nation's coastal resources. The federal government provides grants to states with federally approved coastal management programs. Section 1456 of the CZMA requires that any federal action inside or outside of the coastal zone shall be consistent, to the maximum extent practicable, with the enforceable policies of approved state management programs. No federal license or permit may be granted without giving the state the opportunity to concur that the

project is consistent with the state's coastal policies. The regulations outline the consistency procedures that will be followed by the Trustees.

Compliance: The preferred restoration projects are consistent with the New Jersey, Delaware, and Pennsylvania CZMA programs as determined by concurrence with each state. The necessary permits will be applied for by the Office of Natural Resources Restoration (within NJDEP), Department of Natural Resources and Environmental Control (DNREC), and PADEP, for approval of Waterfront Development/Water Quality Certificate Document, Coastal Zone Management Consistency Permits, and Fresh Water Statewide General Permit #16 for habitat creation and enhancement activities (in each respective state). Permits will be authorized and under compliance with the rules on Coastal Zone Management.

Endangered Species Act (ESA), 16 U.S.C. §§1531, et. seq., 50 C.F.R. Parts 17, 222, 224
The ESA directs all federal agencies to conserve endangered and threatened species and their habitats to the extent their authority allows. Under the Act, the Department of Commerce through NOAA and the Department of the Interior through the U.S. Fish and Wildlife Service (USFWS) publish lists of endangered and threatened species. Section 7 of the Act requires that federal agencies consult with these departments to minimize the effects of federal actions on endangered and threatened species.

Compliance: Coordination with the U.S. Fish & Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) was completed pursuant to Section 7 of the Endangered Species Act. The preferred restoration projects in this Plan will have no to minimal effects on endangered and threatened species. No Biological Assessment or further Section 7 Consultation is needed with the exception of the Blackbird Reserve and Mad Horse Creek restoration projects. The Trustees will work with the Delaware Natural Heritage and Endangered Species Program to determine any future steps, if needed, at Blackbird Reserve. Additional consultation with the USFWS will continue during the design phase of the Mad Horse project to ensure complete compliance with Section 7 of the Endangered Species Act.

Fish and Wildlife Conservation Act, 16 U.S.C. §§2901, et seq.
The purpose of the Fish and Wildlife Conservation Act is to protect the 83 percent of fish and wildlife species that were neglected under prior American law, e.g., non-game species that were diminishing due to habitat loss from development and other environmental ills such as pollution.

Compliance: The preferred restoration projects will either encourage the conservation of non-game fish and wildlife, or have no adverse effect. Coordination with the USFWS, NMFS, and the Delaware, New Jersey, and Pennsylvania state fish and wildlife agencies has been completed.

Fish and Wildlife Coordination Act (FWCA), 16 U.S.C. 661, et seq.
The FWCA requires that federal agencies consult with the U.S. Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), and state wildlife agencies for activities that affect, control, or modify waters of any stream or bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat. This consultation is generally incorporated into the process of complying with Section 404 of the Clean Water Act, NEPA, or other federal permit, license, or review requirements. The preferred

restoration projects will have either a positive effect on fish and wildlife resources or no effect. Coordination will begin between NMFS and the U.S. Fish and Wildlife Service.

Compliance: Coordination with the USFWS, NMFS, and the State fish and wildlife agencies signifies compliance with the Fish and Wildlife Coordination Act. This coordination has been completed.

Watershed Protection and Flood Prevention Act as amended, 16 U.S.C. 1001 et seq.
The Watershed Protection and Flood Prevention Act (Public Law 83-566) authorizes the Secretary of Agriculture to provide technical and financial assistance to entities of state and local governments and tribes (project sponsors) for planning and installing watershed projects. The U.S. Department of Agriculture agency responsible for program management is the Natural Resources Conservation Service.

Compliance: Floodplain impacts were considered prior to selection of the final project plans. The Trustees do not anticipate floodplain impacts with the preferred projects.

Magnuson-Stevens Fishery Conservation and Management Act, as amended and reauthorized by the Sustainable Fisheries Act (Public Law 104-297) (Magnuson-Stevens Act), 16 U.S.C. §§1801 et seq.
The Magnuson-Stevens Act provides for the conservation and management of the Nation's fishery resources within the Exclusive Economic Zone (from the seaward boundary of every state to 200 miles from that baseline). The management goal is to identify and manage the commercially important U.S. marine fisheries. Its goal is to achieve optimum sustainable population harvest levels, and to protect essential fish habitat for federally managed species. The Act also established a program to promote the protection of Essential Fish Habitat (EFH) in the review of projects conducted under Federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. Federal agencies are obligated to consult with the Secretary of Commerce with respect to any action authorized, funded, or undertaken, or proposed to be authorized funded, or undertaken by such agency that may adversely affect any EFH.

Compliance: The preferred restoration projects, under OPA, are being undertaken to make the environment and the public whole for injuries to natural resources and natural resource services by returning injured natural resources and natural resource services to their pre-spill, or baseline condition and compensating for interim losses of natural resources. While the overall goal is to restore and enhance the injured habitat, some restoration activities may convert one habitat to another and must be considered as a potential adverse impact to EFH and analyzed appropriately.

The ecological restoration projects have been reviewed for EFH.

Coordination with NMFS and informal EFH consultation has been completed (Appendix 6). NMFS has reviewed and approved the projects. This action signifies compliance with the EFH provisions of the Magnuson-Stevens Act.

Marine Mammal Protection Act, 16 U.S.C. §§1361 et seq.
The Marine Mammal Protection Act provides for long-term management and research programs for marine mammals. It places a moratorium on the taking and importing of marine mammals and marine mammal products, with limited exceptions. The Department of Commerce is responsible for whales, porpoise, seals, and sea lions. The Department of the Interior is responsible for all other marine mammals.

Compliance: The preferred restoration projects will not have an adverse effect on marine mammals.

Migratory Bird Conservation Act, 126 U.S.C. §§715 et seq.
The Migratory Bird Conservation Act establishes a Migratory Bird Conservation Commission to approve areas of land or water recommended by the Secretary of the Interior for acquisition as reservations for migratory birds. Consultation with state and local government is required prior to acquisition.

Compliance: The preferred restoration projects will have no adverse effect on migratory birds. Migratory birds are expected to benefit from creation of new marsh habitat.

Archeological Resources Protection Act, 16 U.S.C. 470 et seq.
The purpose of the Archaeological Resources Protection Act is to secure, for the present and future benefit of the American people, the protection of archaeological resources and sites which are on public lands and Indian lands, and to foster increased cooperation and exchange of information between governmental authorities, the professional archaeological community, and private individuals having collections of archaeological resources and data that were obtained before 31 October 1979.

Compliance: The wetland restoration sites will be surveyed to determine values as archaeological resources, and the oyster restoration sites will avoid any submerged archaeological resources.

Information Quality Guidelines issued pursuant to Public Law 106-554
Information disseminated by federal agencies to the public after October 1, 2002, is subject to information quality guidelines developed by each agency pursuant to Section 515 of Public Law 106-554 that are intended to ensure and maximize the quality of such information (i.e., the objectivity, utility, and integrity of such information).

Compliance: This final RP/EA is an information product covered by information quality guidelines established by NOAA and DOI for this purpose. The quality of the information contained herein is consistent with the applicable guidelines.

Section 508 of the Rehabilitation Act
Section 508 (29 U.S.C. 794d) of the Rehabilitation Act requires all Federal agencies must give disabled employees and members of the public access to information that is comparable to the access available to others. Section 508 was enacted partly to eliminate barriers in information technology. For web accessibility under Section 508, a text equivalent must be available for any

non-text element such as images, navigation arrows, multimedia objects (audio or video), logos, photographs, or artwork in order to enable users with disabilities to distinguish important content from merely decorative images. Section 508 compliance also includes making accessible other multimedia and outreach materials and platforms, acquisition of equipment and other assistive technologies (phones, PDAs, computers, scanners, etc.) and computer software compliance.

Compliance: The Trustees have complied with their agency's web policies, based on the World Wide Web Consortium Web Accessibility Initiative.

Executive Order 11990 (42 FR 26,961) - Protection of Wetlands
Executive Order 11990 requires each federal agency to take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for: acquiring, managing, and disposing of federal lands and facilities; providing federally undertaken, financed, or assisted construction and improvements; and conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities

Compliance: The Trustees have concluded that the preferred restoration projects will meet the goals of this executive order.

Executive Order 12898 (59 Fed. Reg. 7,629) – Environmental Justice
Executive Order 12898 requires each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. EPA and the Council on Environmental Quality (CEQ) have emphasized the importance of incorporating environmental justice review in the analyses conducted by federal agencies under NEPA and of developing mitigation measures that avoid disproportionate environmental effects on minority and low-income populations.

Compliance: The Trustees have concluded that there are no low-income or ethnic minority communities that will be adversely affected by the preferred restoration projects.

Executive Order Number 11514 (35 FR 4,247) - Protection and Enhancement of Environmental Quality
The purpose of Executive Order 11514 is to protect and enhance the quality of the Nation's environment to sustain and enrich human life. Federal agencies shall initiate measures needed to direct their policies, plans, and programs so as to meet national environmental goals.

Compliance: An Environmental Assessment (EA) was prepared as part of this final RP/EA and environmental coordination as required by NEPA has been completed.

Executive Order Number 12962 (60 FR 30,769) – Recreational Fisheries
The purpose of Executive Order 12962 is to conserve, restore, and enhance aquatic systems to provide for increased recreational fishing opportunities nationwide.

Compliance: The preferred restoration projects will help ensure the protection of recreational fisheries and the services they provide. These projects will have no adverse effects on recreational fisheries.

Executive Order Number 13112 (64 FR 6,183) – Invasive Species
The purpose of Executive Order 13112 is to prevent the introduction of invasive species and provide for their control, and to minimize the economic, ecological, and human health impacts that invasive species cause.

Compliance: The preferred ecological restoration projects will not cause or promote the introduction or spread of invasive species. Annual surveys for invasive species (specifically *Phragmites*) and actions to control them should they be present in the created tidal marshes have been budgeted into costs for these projects. The preferred lost use projects will also not cause or promote the introduction or spread of invasive species.

Appendix 4. Supplemental restoration planning information

HEA Inputs and Results for Salt Marsh Restoration at Mad Horse Creek

Inputs:

Project Implementation	2010
Maximum Ecological Service	85 percent
Baseline Ecological Service	10 percent
Years to maximum service	15
Curve for Service Gain	Logistic
Project life span	50
Discount Rate[1]	3 percent

Results:

1 acre restored marsh provides 13.4 DSAYs of ecological service.

Annual Calculations:

Year	Ecological Service Improvement (per acre)	Discounted Ecological Service (per acre)	Year	Ecological Service Improvement (per acre)	Discounted Ecological Service (per acre)
2010	1%	0.01	2035	74%	0.32
2011	2%	0.02	2036	74%	0.31
2012	4%	0.04	2037	74%	0.30
2013	8%	0.06	2038	74%	0.29
2014	13%	0.11	2039	74%	0.28
2015	21%	0.16	2040	74%	0.27
2016	32%	0.24	2041	74%	0.26
2017	43%	0.31	2042	74%	0.26
2018	54%	0.38	2043	74%	0.25
2019	62%	0.42	2044	74%	0.24
2020	67%	0.44	2045	74%	0.23
2021	71%	0.45	2046	74%	0.23
2022	73%	0.45	2047	74%	0.22
2023	74%	0.45	2048	74%	0.21
2024	74%	0.44	2049	74%	0.21
2025	74%	0.42	2050	74%	0.20
2026	74%	0.41	2051	74%	0.20
2027	74%	0.40	2052	74%	0.19
2028	74%	0.39	2053	74%	0.19
2029	74%	0.38	2054	74%	0.18
2030	74%	0.37	2055	74%	0.17
2031	74%	0.35	2056	74%	0.17
2032	74%	0.34	2057	74%	0.16
2033	74%	0.33	2058	74%	0.16
2034	74%	0.32	2059	74%	0.15
				Sum (2010-2059):	**13.4**

1. Values are discounted to 2006, the year for which injury DSAYs are calculated.

HEA Inputs and Results for Marsh Restoration at Lardner's Point

Inputs:

Project Implementation	2009
Maximum Ecological Service	85 percent
Baseline Ecological Service	0 percent
Years to maximum service	15
Curve for Service Gain	Logistic
Project life span	50
Discount Rate[1]	3 percent

Results:

1 acre restored marsh provides 15.6 DSAYs of ecological service.

Annual Calculations:

Year	Ecological Service Improvement (per acre)	Discounted Ecological Service (per acre)	Year	Ecological Service Improvement (per acre)	Discounted Ecological Service (per acre)
2009	2%	0.01	2034	84%	0.37
2010	3%	0.03	2035	84%	0.36
2011	5%	0.04	2036	84%	0.35
2012	9%	0.07	2037	84%	0.34
2013	15%	0.12	2038	84%	0.33
2014	24%	0.19	2039	84%	0.32
2015	36%	0.28	2040	84%	0.31
2016	49%	0.36	2041	84%	0.30
2017	61%	0.44	2042	84%	0.29
2018	70%	0.49	2043	84%	0.28
2019	76%	0.52	2044	84%	0.27
2020	80%	0.53	2045	84%	0.27
2021	82%	0.53	2046	84%	0.26
2022	83%	0.52	2047	84%	0.25
2023	84%	0.51	2048	84%	0.24
2024	84%	0.49	2049	84%	0.24
2025	84%	0.48	2050	84%	0.23
2026	84%	0.47	2051	84%	0.22
2027	84%	0.45	2052	84%	0.22
2028	84%	0.44	2053	84%	0.21
2029	84%	0.43	2054	84%	0.20
2030	84%	0.41	2055	84%	0.20
2031	84%	0.40	2056	84%	0.19
2032	84%	0.39	2057	84%	0.19
2033	84%	0.38	2058	84%	0.18
				Sum (2009-2058):	**15.6**

1. Values are discounted to 2006, the year for which injury DSAYs are calculated.

HEA Inputs and Results for Tributary Restoration Via Dam Removal and Riparian Restoration on Darby Creek

Inputs:

Years to full service	5
Curve for Service Gain	Linear
Project life span[1]	In perpetuity
Discount Rate[2]	3 percent

Results:

1 acre of tributary habitat with 100 percent ecological improvement provides 29.64 DSAYs
1 acre of tributary habitat with 5 percent ecological improvement provides 1.48 DSAYs

Annual Calculations (First 50 years):

Year	Ecological Service (per acre)	Discounted Ecological Service (per acre)	Year	Ecological Service (per acre)	Discounted Ecological Service (per acre)
2009	0.20	0.18	2034	1.00	0.44
2010	0.40	0.36	2035	1.00	0.42
2011	0.60	0.52	2036	1.00	0.41
2012	0.80	0.67	2037	1.00	0.40
2013	1.00	0.81	2038	1.00	0.39
2014	1.00	0.79	2039	1.00	0.38
2015	1.00	0.77	2040	1.00	0.37
2016	1.00	0.74	2041	1.00	0.36
2017	1.00	0.72	2042	1.00	0.35
2018	1.00	0.70	2043	1.00	0.33
2019	1.00	0.68	2044	1.00	0.33
2020	1.00	0.66	2045	1.00	0.32
2021	1.00	0.64	2046	1.00	0.31
2022	1.00	0.62	2047	1.00	0.30
2023	1.00	0.61	2048	1.00	0.29
2024	1.00	0.59	2049	1.00	0.28
2025	1.00	0.57	2050	1.00	0.27
2026	1.00	0.55	2051	1.00	0.26
2027	1.00	0.54	2052	1.00	0.26
2028	1.00	0.52	2053	1.00	0.25
2029	1.00	0.51	2054	1.00	0.24
2030	1.00	0.49	2055	1.00	0.23
2031	1.00	0.48	2056	1.00	0.23
2032	1.00	0.46	2057	1.00	0.22
2033	1.00	0.45	2058	1.00	0.22
				Total (2009-2508):	**29.64**

1. Ecological benefit is calculated for 500 years, which provides benefits in perpetuity based on the number of significant figures used in these calculations.
2. Values are discounted to 2006, the year for which injury DSAYs are calculated.

HEA Inputs and Results for "Direct" Restoration (channels, fringing habitat, and pools) at John Heinz National Wildlife Refuge

Inputs:

Project Implementation	2010
Maximum Ecological Service	80 percent
Baseline Ecological Service	10 percent
Years to maximum service	3
Curve for Service Gain	Linear
Project life span	50
Discount Rate[1]	3 percent

Results:

1 acre restored habitat provides 15.8 DSAYs of ecological service.

Annual Calculations:

Year	Ecological Service (per acre)	Discounted Ecological Service (per acre)	Year	Ecological Service (per acre)	Discounted Ecological Service (per acre)
2010	23%	0.21	2035	70%	0.30
2011	47%	0.40	2036	70%	0.29
2012	70%	0.58	2037	70%	0.28
2013	70%	0.57	2038	70%	0.27
2014	70%	0.55	2039	70%	0.26
2015	70%	0.53	2040	70%	0.25
2016	70%	0.52	2041	70%	0.25
2017	70%	0.50	2042	70%	0.24
2018	70%	0.49	2043	70%	0.23
2019	70%	0.47	2044	70%	0.23
2020	70%	0.46	2045	70%	0.22
2021	70%	0.45	2046	70%	0.21
2022	70%	0.43	2047	70%	0.21
2023	70%	0.42	2048	70%	0.20
2024	70%	0.41	2049	70%	0.20
2025	70%	0.40	2050	70%	0.19
2026	70%	0.38	2051	70%	0.18
2027	70%	0.37	2052	70%	0.18
2028	70%	0.36	2053	70%	0.17
2029	70%	0.35	2054	70%	0.17
2030	70%	0.34	2055	70%	0.16
2031	70%	0.33	2056	70%	0.16
2032	70%	0.32	2057	70%	0.15
2033	70%	0.31	2058	70%	0.15
2034	70%	0.30	2059	70%	0.15
				Sum (2010-2059):	**15.8**

1. Values are discounted to 2006, the year for which injury DSAYs are calculated.

HEA Inputs and Results for "Indirect" Restoration Benefits (more frequent wetting of entire site) at John Heinz National Wildlife Refuge

Inputs:

Project Implementation	2010
Increase in Ecological Service	10 percent
Years to maximum service	3
Curve for Service Gain	Linear
Project life span	50
Discount Rate[1]	3 percent

Results:

1 acre restored habitat provides 2.3 DSAYs of ecological service.

Annual Calculations:

Year	Ecological Service (per acre)	Discounted Ecological Service (per acre)	Year	Ecological Service (per acre)	Discounted Ecological Service (per acre)
2010	3%	0.03	2035	10%	0.04
2011	7%	0.06	2036	10%	0.04
2012	10%	0.08	2037	10%	0.04
2013	10%	0.08	2038	10%	0.04
2014	10%	0.08	2039	10%	0.04
2015	10%	0.08	2040	10%	0.04
2016	10%	0.07	2041	10%	0.04
2017	10%	0.07	2042	10%	0.03
2018	10%	0.07	2043	10%	0.03
2019	10%	0.07	2044	10%	0.03
2020	10%	0.07	2045	10%	0.03
2021	10%	0.06	2046	10%	0.03
2022	10%	0.06	2047	10%	0.03
2023	10%	0.06	2048	10%	0.03
2024	10%	0.06	2049	10%	0.03
2025	10%	0.06	2050	10%	0.03
2026	10%	0.06	2051	10%	0.03
2027	10%	0.05	2052	10%	0.03
2028	10%	0.05	2053	10%	0.02
2029	10%	0.05	2054	10%	0.02
2030	10%	0.05	2055	10%	0.02
2031	10%	0.05	2056	10%	0.02
2032	10%	0.05	2057	10%	0.02
2033	10%	0.05	2058	10%	0.02
2034	10%	0.04	2059	10%	0.02
				Sum (2009-2058):	**2.3**

1. Values are discounted to 2006, the year for which injury DSAYs are calculated.

HEA Inputs and Results for Grasslands (Mad Horse Creek), Pasture (Blackbird Reserve), and Pond (Blackbird Reserve) Benefits

Inputs:		**Habitat**	**kg/acre/yr**	**Discounted kg/acre (lifetime)**
Project Implementation	2009	Pasture	4,860	115,557
Maximum Ecological Service	100 percent	Pond	1,805	42,949
Years to maximum service	2	Grasslands	2,120	48,897[2]
Curve for Service Gain	Linear			
Project life span	50			
Discount Rate[1]	3 percent			

Results:

1 kg additional production provides 23.80 discounted kg of ecological service.

Annual Calculations:

Year	Ecological Service (per kg)	Discounted Ecological Service (per kg)	Year	Ecological Service (per kg)	Discounted Ecological Service (per kg)
2009	50%	0.46	2034	100%	0.44
2010	100%	0.89	2035	100%	0.42
2011	100%	0.86	2036	100%	0.41
2012	100%	0.84	2037	100%	0.40
2013	100%	0.81	2038	100%	0.39
2014	100%	0.79	2039	100%	0.38
2015	100%	0.77	2040	100%	0.37
2016	100%	0.74	2041	100%	0.36
2017	100%	0.72	2042	100%	0.35
2018	100%	0.70	2043	100%	0.33
2019	100%	0.68	2044	100%	0.33
2020	100%	0.66	2045	100%	0.32
2021	100%	0.64	2046	100%	0.31
2022	100%	0.62	2047	100%	0.30
2023	100%	0.61	2048	100%	0.29
2024	100%	0.59	2049	100%	0.28
2025	100%	0.57	2050	100%	0.27
2026	100%	0.55	2051	100%	0.26
2027	100%	0.54	2052	100%	0.26
2028	100%	0.52	2053	100%	0.25
2029	100%	0.51	2054	100%	0.24
2030	100%	0.49	2055	100%	0.23
2031	100%	0.48	2056	100%	0.23
2032	100%	0.46	2057	100%	0.22
2033	100%	0.45	2058	100%	0.22
				Sum (2009-2058):	23.80

1. Values are discounted to 2006, the year for which injury DSAYs are calculated.
2. Grassland construction begins in 2010; value is discounted an additional 3 percent.

HEA Inputs and Results for Wet Meadow Restoration Benefits at Mad Horse Creek

Inputs:		**Habitat**	**kg/acre/yr**	**Discounted kg/acre (lifetime)**
Project Implementation	2010	Wet Meadows	7,155	132,706
Maximum Ecological Service	85 percent			
Years to maximum service	5			
Curve for Service Gain	Linear			
Project life span	50			
Discount Rate[1]	3 percent			

Results:

1 kg additional production provides 18.55 discounted kg of ecological service.

Annual Calculations:

Year	Ecological Service (per acre)	Discounted Ecological Service (per acre)	Year	Ecological Service (per acre)	Discounted Ecological Service (per acre)
2010	17%	0.15	2035	85%	0.36
2011	34%	0.29	2036	85%	0.35
2012	51%	0.43	2037	85%	0.34
2013	68%	0.55	2038	85%	0.33
2014	85%	0.67	2039	85%	0.32
2015	85%	0.65	2040	85%	0.31
2016	85%	0.63	2041	85%	0.30
2017	85%	0.61	2042	85%	0.29
2018	85%	0.60	2043	85%	0.28
2019	85%	0.58	2044	85%	0.28
2020	85%	0.56	2045	85%	0.27
2021	85%	0.55	2046	85%	0.26
2022	85%	0.53	2047	85%	0.25
2023	85%	0.51	2048	85%	0.25
2024	85%	0.50	2049	85%	0.24
2025	85%	0.48	2050	85%	0.23
2026	85%	0.47	2051	85%	0.22
2027	85%	0.46	2052	85%	0.22
2028	85%	0.44	2053	85%	0.21
2029	85%	0.43	2054	85%	0.21
2030	85%	0.42	2055	85%	0.20
2031	85%	0.41	2056	85%	0.19
2032	85%	0.39	2057	85%	0.19
2033	85%	0.38	2058	85%	0.18
2034	85%	0.37	2059	85%	0.18
				Sum (2010-2059):	18.55

1. Values are discounted to 2006, the year for which injury DSAYs are calculated.

HEA Inputs and Results for Agricultural Waste (Mad Horse Creek and Blackbird Reserve) and Agricultural Crops (Blackbird Reserve)

Inputs:		**Habitat**	**kg/acre/yr**	**Discounted kg/acre (lifetime)**
Project Implementation	2009	Ag. Waste	131	3,170
Maximum Ecological Service	100 percent	Ag. Crops	3,320	71,679
Years to maximum service	1			
Curve for Service Gain	Linear			
Project life span	50			
Discount Rate[1]	3 percent			

Results:

1 kg additional production provides 24.25 discounted kg of ecological service.

Annual Calculations:

Year	Ecological Service (per kg)	Discounted Ecological Service (per kg)	Year	Ecological Service (per kg)	Discounted Ecological Service (per kg)
2009	100%	0.92	2034	100%	0.44
2010	100%	0.89	2035	100%	0.42
2011	100%	0.86	2036	100%	0.41
2012	100%	0.84	2037	100%	0.40
2013	100%	0.81	2038	100%	0.39
2014	100%	0.79	2039	100%	0.38
2015	100%	0.77	2040	100%	0.37
2016	100%	0.74	2041	100%	0.36
2017	100%	0.72	2042	100%	0.35
2018	100%	0.70	2043	100%	0.33
2019	100%	0.68	2044	100%	0.33
2020	100%	0.66	2045	100%	0.32
2021	100%	0.64	2046	100%	0.31
2022	100%	0.62	2047	100%	0.30
2023	100%	0.61	2048	100%	0.29
2024	100%	0.59	2049	100%	0.28
2025	100%	0.57	2050	100%	0.27
2026	100%	0.55	2051	100%	0.26
2027	100%	0.54	2052	100%	0.26
2028	100%	0.52	2053	100%	0.25
2029	100%	0.51	2054	100%	0.24
2030	100%	0.49	2055	100%	0.23
2031	100%	0.48	2056	100%	0.23
2032	100%	0.46	2057	100%	0.22
2033	100%	0.45	2058	100%	0.22
				Sum (2009-2058):	24.25

1. Values are discounted to 2006, the year for which injury DSAYs are calculated.

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

MITIGATION PROJECT MONITORING REPORTS FOR TIDAL WETLAND

CHECKLIST FOR COMPLETENESS

(8/00)

All mitigation sites must be monitored starting the first full growing season after the construction/planting of the mitigation project is completed. The mitigation project must be monitored for three **full** growing seasons. Below are the submission requirements for a complete monitoring report. Please read each section and check each area after you have fully completed the information for each applicable requirement.

Section A: All monitoring reports must include five copies of the following information

- ☐ 1. A USGS quad map, and a county road map showing the location of the mitigation site, including the lot and block of the mitigation site. Furthermore provide a copy of an aerial photograph of the mitigation site. This information must clearly indicate the point(s) of access to the mitigation site.
- ☐ 2. A copy of the permit that required the mitigation.
- ☐ 3. A brief description of the mitigation project.
- ☐ 4. Photographs of the mitigation site with a location map indicating where they were taken on the site.
- ☐ 5. An assessment of the planted vegetation as well as the species that are naturally colonizing the site. This assessment shall include the location and percent coverage of each species.
- ☐ 6. Documentation demonstrating that the hydrologic regime specified in the mitigation proposal, which proves the mitigation site is a wetland, is present. The documentation shall include, as appropriate, monitoring well data, stream gauge data, photographs and/or field observation notes collected throughout the monitoring period.
- ☐ 7. Data sheets from sampling points, which describe the vegetation present, the percent coverage of the vegetation, soil borings and location of the water table.
- ☐ 8. Documentation, based on field data, that the goals of the wetland mitigation project (including the transition area) as stated in the approved wetland mitigation proposal will be satisfied.
- ☐ 9. A narrative evaluating the success/failure of the site.
- ☐ 10. If problems with the site are identified, identify actions that should be taken which will permanently rectify the situation.

Section B: In addition to the information required in Section A above, all successful first full growing season monitoring reports must include the following information. If any one or more of the below listed parameters are not met then this full growing season monitoring period must be repeated until satisfied.

- 1. Documentation that demonstrates through soil borings that the appropriate soil was used on the site as indicated in the mitigation approval.

- 2. As built plans, which demonstrate that the site was graded and planted in accordance with the approved mitigation plans. Any deviations from the approved mitigation plans must be highlighted and explained to the Program for review and approval.

- 3. Documentation that the hydrologic regime specified in the approved mitigation proposal, which proves the mitigation site is a wetland, appears to be present. Any deviations from the approved proposal must be highlighted and explained to the Program for review and approval.

- 4. Documentation that demonstrates that there is at least 30% areal coverage of the planted vegetation or target hydrophytes which are species native to the area and similar to ones identified on the mitigation planting plan.

- 5. Documentation that demonstrates less than 10 percent of the site is occupied by invasive or noxious species such as but not limited to *Phalaris arundinacea* (Reed canary grass), *Phragmities australis* (Common reed grass), *Pueraria montana* (Kudzu), *Typha latifloia* (Broad-leaved cattail), *Typha angustifolia* (Narrowed leaved cattail), *Lythrum salicaria* (Purple loosestrife), *Ailanthus altissima* (Tree-of-heaven), *Berberis thunbergi* (Japanese barberry), *Berberis vulgaris* (Common barberry*), Elaeagnus angustifloia* (Russian olive), *Elaeagnus umbellata* (Autumn olive), *Ligustrum obtusifolium* (Japanese privet), *Ligustrum vulgare* (Common privet) and *Rosa multiforia* (Multiflora rose).

Section C: In addition to the information required in Section A above, all successful second full growing season monitoring reports must include the following information. If any one or more of the below listed parameters are not met then this full growing season monitoring period must be repeated until satisfied.

- 1. Documentation that the hydrologic regime specified in the approved mitigation proposal, which proves the mitigation site is a wetland continues to appear to be present.

- 2. Documentation that demonstrates that there is at least 60% areal coverage of the planted vegetation or target hydrophytes which are species native to the area and similar to ones identified on the mitigation planting plan.

- 3. Documentation that demonstrates less than 10 percent of the site is occupied by invasive or noxious species such as but not limited to *Phalaris arundinacea* (Reed canary grass), *Phragmities australis* (Common reed grass), *Pueraria montana* (Kudzu), *Typha latifloia* (Broad-leaved cattail), *Typha angustifolia* (Narrowed leaved cattail), *Lythrum salicaria* (Purple loosestrife), *Ailanthus altissima* (Tree-of-heaven), *Berberis thunbergi* (Japanese barberry), *Berberis vulgaris* (Common barberry*), Elaeagnus angustifloia* (Russian olive), *Elaeagnus umbellata* (Autumn olive), *Ligustrum obtusifolium* (Japanese privet), *Ligustrum vulgare* (Common privet) and *Rosa multiforia* (Multiflora rose).

Section D: In addition to the information required in Section A above, all successful third and final full growing season monitoring reports must include the following information. If any one or more of the

below listed parameters are not met then this full growing season monitoring period must be repeated until satisfied.

- 1. Documentation which demonstrates that the goals of the wetland mitigation project (including the required transition area) as stated in the approved wetlands mitigation proposal and the permit, has been satisfied. This documentation must include information concerning invasive/noxious plant species and the percent coverage of these species on the site.

- 2. Documentation which demonstrates that the proposed hydrologic regime as specified in the mitigation proposal, which proves the mitigation site is a wetland has been satisfied. The documentation shall include when appropriate monitoring well data, stream gauge data, photographs and field observation notes collected throughout the monitoring period.

- 3. Documentation that demonstrates that there is at least 85% areal coverage of the planted vegetation or target hydrophytes which are species native to the area and similar to ones identified on the mitigation planting plan.

- 4. A field wetland delineation of the wetlands mitigation project based on techniques specified in the Federal Manual for Identifying and Delineation Jurisdictional Wetlands (1989).

- 5. A plan showing the flagged wetland delineation referenced above for review and approval by the Program. The wetland line must include global positioning system data points.

Appendix 5. Preparers, agencies, and persons consulted

Dr. Jim Hoff, National Pollution Funds Center, formerly with the National Oceanic and Atmospheric Administration

National Oceanic and Atmospheric Administration
Eric English, National Ocean Service, Office of Response and Restoration
Craig Woolcott, National Marine Fisheries Service, Office of Habitat Conservation
Linda Burlington, Office of General Counsel
Kate Clark, National Ocean Service, Office of Response and Restoration
Bethany Bearmore, National Marine Fisheries Service, Office of Habitat Conservation
Kristin Rusello, National Ocean Service, Office of Response and Restoration
Kate Barfield, Office of General Counsel
Anthony Dvarskas, National Ocean Service, Office of Response and Restoration
Mary Andrews, National Marine Fisheries Service, Office of Habitat Conservation

New Jersey
David Bean, New Jersey Department of Environmental Protection
John Sacco, New Jersey Department of Environmental Protection
Lauren Caruso-Garofalo, New Jersey Office of the Attorney General
Kathy Clark, Department of Environmental Protection, Division of Fish and Wildlife
Ted Nichols, Department of Environmental Protection, Division of Fish and Wildlife

Pennsylvania
Stan Sneath, Pennsylvania Department of Environmental Protection
Bill Capouillez, Pennsylvania Game Commission
Mark Hartle, Pennsylvania Fish and Boat Commission
Bill Pouss, Pennsylvania Game Commission
Alan Everett, Pennsylvania Department of Environmental Protection
Autumn Sabo, Pennsylvania Department of Conservation and Natural Resources
John Dunn, Pennsylvania Game Commission
Mike Boyer, Pennsylvania Department of Environmental Protection

Delaware
Rob Hossler, Delaware Department of Natural Resources and Environmental Control
Bob Kuehl, Delaware Office of the Attorney General
Kevin Kalasz, Delaware Department of Natural Resources and Environmental Control
Rick Greene, Delaware Department of Natural Resources and Environmental Control
Stu Michels, Delaware Department of Natural Resources and Environmental Control
Rick Cole, Delaware Department of Natural Resources and Environmental Control

U.S. Department of the Interior
Sherry Krest, U.S. Fish and Wildlife Service
Marcia Gittes, Office of the Solicitor
Al Rizzo, U.S. Fish and Wildlife Service
Brian Marsh, U.S. Fish and Wildlife Service

Fred Pinkney, U.S. Fish and Wildlife Service
Doug Forsell, U.S. Fish and Wildlife Service

U.S. Department of Justice
Rachel Jacobson

Non-Agency Persons
Dr. Jacqui Michel, Research Planning Inc.
Heidi Hinkledey Dunagan, Research Planning Inc.
Zach Nixon, Research Planning Inc.
Dr. Don McDonald, MacDonald Environmental Sciences Ltd.
Dr. Chris Sommerfield, University of Delaware
Greg Douglas, New Fields Environmental Forensics Practices L.L.C.
Dr. D. Michael Fry, American Bird Conservancy
Dr. George R. Parsons, University of Delaware
Dr. Pete Peterson, University of North Carolina at Chapel Hill
Mike Donlan, Industrial Economics
Dr. Ann Jones, Industrial Economics
Greg Challenger, Polaris, Inc.
Gary Mauseth, Polaris, Inc.
Tim Bergere, Esq., Montgomery, McCracken, Walker &Rhoads
Gene O'Connor, Esq., Fowler, Rodriguez & Chalois

Appendix 6. Correspondence with NOAA's National Marine Fisheries Service and NOAA's Coastal and Estuarine Land Conservation Program

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Habitat Conservation Division
James J. Howard Marine
Sciences Laboratory
74 Magruder Road
Highlands, New Jersey 07732

October 1, 2008

TO: Bethany Bearmore
NOAA Restoration Center
James J. Howard Marine Sciences Laboratory
74 Magruder Road
Highlands, New Jersey 07732

SUBJECT: Augustine Boat Ramp –revised plans – rock jetty construction
Augustine Beach, New Castle Co. DE

Karen Greene
(Reviewing Biologist)

We have reviewed the information provided to us regarding the above subject project. We offer the following preliminary comments pursuant to the Endangered Species Act, the Fish and Wildlife Coordination Act and the Magnuson-Stevens Fishery Conservation and Management Act:

Endangered Species Act

Several species of sea turtles are of each year including the threatened loggerhead (*Caretta caretta*), endangered Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*) and green (*Chelonia mydas*) sea turtles are present in Delaware Bay, mainly during the late spring, summer and early fall when water temperatures are relatively warm. Federally endangered shortnose sturgeon (*Acipenser brevirostrum*) may be found in the Delaware River up to at least Lambertville, New Jersey (river km 238). The activities proposed are covered under the no effect letter issued to the Philadelphia District Army Corps of Engineers in December 2004. Should project plans change, or if new information becomes available that changes the basis for this determination, or new species are listed or critical habitat designated, consultation also should be reinitiated.

Fish and Wildlife Coordination Act

The following may be present in the project area: resident, forage and benthic species including winter flounder, summer flounder, windowpane, bay anchovy, bluefish, weakfish, river herring, striped bass, oysters, horseshoe crabs and blue crabs. Based upon the project location and the work proposed, we have no recommendations to offer on this project.

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat

The Delaware Bay has been designated as Essential Fish Habitat (EFH) for one or more federally managed species. Based upon the location and nature of the work proposed, impacts to EFH are expected to be minimal. As a result, additional consultation as part of the federal permit process will not be necessary. For a listing of EFH and further information please go to our website at: http://www.nero.noaa.gov/hcd. If you wish to discuss this further, please call Karen Greene at 732-872-3023.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Habitat Conservation Division
James J. Howard Marine
Sciences Laboratory
74 Magruder Road
Highlands, New Jersey 07732

June 4, 2008

TO: Bethany Bearmore
NOAA Restoration Center
James J. Howard Marine Sciences Laboratory
74 Magruder Road
Highlands, New Jersey 07732

SUBJECT: Proposed Blackbird Reserve Restoration Site
New Castle Co., DE

Karen Greene
(Reviewing Biologist)

We have reviewed the information provided to us regarding the above subject project. We offer the following preliminary comments pursuant to the Endangered Species Act, the Fish and Wildlife Coordination Act and the Magnuson-Stevens Fishery Conservation and Management Act:

Endangered Species Act

No threatened or endangered species under the jurisdiction of the NMFS are known to occur in the project area. As a result, further consultation is not required. However should project plans change that would change the basis for determination, or if new species or critical habitat is designated, consultation should be reinitiated.

Fish and Wildlife Coordination Act

A wide variety of resources under NMFS jurisdiction occur within the lower reaches of Blackbird Creek including anadromous and resident fish, forage and benthic species such as alewife, blueback herring, striped bass, weakfish, white perch, bay anchovy and mummichog.. The activities proposed are not likely to impacts these species adversely. Any impacts to water quality during the construction are likely to be temporary and minor. As a result, we have no additional recommendations to offer.

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat

The estuarine waters of Blackbird Creek have been designated as Essential Fish Habitat (EFH) for one or more species. Restoration activities at the site may have minor temporary impacts of EFH and federally managed species. These can be minimized by using best management practices to protect water quality and reduce sediments entering the creek. The restoration of the site will benefit EFH. Because the impacts of the project are expected to be minor in nature and temporary, further EFH consultation will not be necessary required as part of the federal permit process. Should project plans change that would change the basis for determination, or if new species or EFH are designated, the federal action agency should reinitiate consultation. For a listing of EFH and further information, please go to our website at: http://www.nero.noaa.gov/hcd. If you wish to discuss this further, please call 732-872-3023.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Habitat Conservation Division
James J. Howard Marine
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May 5, 2008

TO: Bethany Bearmore
NOAA Restoration Center
James J. Howard Marine Sciences Laboratory
74 Magruder Road
Highlands, New Jersey 07732

SUBJECT: Proposed Darby Creek Restoration Site
Philadelphia, PA

Karen Greene
(Reviewing Biologist)

We have reviewed the information provided to us regarding the above subject project. We offer the following preliminary comments pursuant to the Endangered Species Act, the Fish and Wildlife Coordination Act and the Magnuson-Stevens Fishery Conservation and Management Act:

Endangered Species Act

No threatened or endangered species under the jurisdiction of the NMFS are known to occur in the project area. As a result, further consultation is not required. However should project plans change that would change the basis for determination, or if new species or critical habitat is designated, consultation should be reinitiated.

Fish and Wildlife Coordination Act

Anadromous fish including striped bass, alewife, blueback herring and American shad may be found in portions of Darby Creek. Removal of the remnant bridge pier, the Darby Borough Dam, the SEPTA dam and the dam at Kent Park and the restoration of the surrounding riparian corridor will benefit these species. Since anadromous fish occur at the most downstream barrier, we recommend that the removals begin at the most upstream blockage and work downstream, or that the dam removals be avoided from 3/1 to 6/30 to minimize impacts to anadromous fish that will congregate and possibly spawn at base of the dam.

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat

No EFH has been designated in the project area. An EFH consultation by the federal action agency will not be required as part of the permit process. Should project plans change that would modify the basis for this determination, or if new species or EFH is designated, consultation should be reinitiated. For a listing of EFH and further information, please go to our website at: www.nero.noaa.gov/hcd.

If you wish to discuss this further, please call 732-872-3023

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Habitat Conservation Division
James J. Howard Marine
Sciences Laboratory
74 Magruder Road
Highlands, New Jersey 07732

November 20, 2008

TO: Bethany Bearmore
NOAA Restoration Center
James J. Howard Marine Sciences Laboratory
74 Magruder Road
Highlands, New Jersey 07732

SUBJECT: Proposed John Heinz National Wildlife Refuge Site
Philadelphia, PA
Supplemental comments

Karen Greene
(Reviewing Biologist)

We have reviewed the information provided to us regarding the above subject project. We offer the following preliminary comments pursuant to the Endangered Species Act, the Fish and Wildlife Coordination Act and the Magnuson-Stevens Fishery Conservation and Management Act:

Endangered Species Act

No threatened or endangered species under the jurisdiction of the NMFS are known to occur in the project area. As a result, further consultation is not required. However should project plans change that would change the basis for determination, or if new species or critical habitat is designated, consultation should be reinitiated.

Fish and Wildlife Coordination Act

Freshwater tidal wetlands along the Delaware River provide valuable nursery and forage habitat for a number of species of concern to NMFS including anadromous fish such as striped bass, alewife, blueback herring and American shad. Restoration of this habitat will benefit these and many other species. We support the plans to restore this site.

We understand that portions of the site may contain elevated levels of contaminants. Sediment sampling should be done at the site, if it has not already occurred, to determine the nature and extent of any contamination. The results of the testing should be used to determine how to best design the restoration of the site to avoid exposing contaminated hot spots. .

Anadromous fish including striped bass, alewife, blueback herring and American shad may be found in portions of Darby Creek. To minimize impact to anadromous fish, in-water work within the creek should be avoided from 3/1 to 6/30.

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat

No EFH has been designated in the project area. An EFH consultation by the federal action agency will not be required as part of the permit process. Should project plans change that would modify the basis for this determination, or if new species or EFH is designated, consultation should be reinitiated. For a listing of EFH and further information, please go to our website at: www.nero.noaa.gov/hcd.

If you wish to discuss this further, please call 732-872-3023

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Habitat Conservation Division
James J. Howard Marine
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74 Magruder Road
Highlands, New Jersey 07732

May 5, 2008

TO: Bethany Bearmore
NOAA Restoration Center
James J. Howard Marine Sciences Laboratory
74 Magruder Road
Highlands, New Jersey 07732

SUBJECT: Proposed Lardner's Point Restoration Site
Philadelphia, PA

Karen Greene
(Reviewing Biologist)

We have reviewed the information provided to us regarding the above subject project. We offer the following preliminary comments pursuant to the Endangered Species Act, the Fish and Wildlife Coordination Act and the Magnuson-Stevens Fishery Conservation and Management Act:

Endangered Species Act

Threatened and endangered shortnose sturgeon may be present in the project area at certain times of the Once project plans have been developed, the lead federal action agency should contact NMFS Protected Resources Division to initiate coordination on this project. Requests for coordination can be addressed to: Ms. Julie Crocker of NOAA Fisheries Service's Protected Resources Division, One Blackburn Drive, Gloucester, MA 01930-2298.

Fish and Wildlife Coordination Act

Anadromous fish including striped bass, alewife, blueback herring and American shad may be found in the project area. Atlantic sturgeon, a candidate for listing under the ESA also occur in the Delaware River. The restoration of the site will benefit resources of concern to NMFS, but removal and demolition of the dilapidated ferry dock and boat ramp, may affect the migration and spawning of anadromous fish. These actions should be avoided from avoided from 3/1 to 6/30.

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat

No EFH has been designated in the project area. An EFH consultation by the federal action agency will not be required as part of the permit process. Should project plans change that would modify the basis for this determination, or if new species or EFH is designated, consultation should be reinitiated. For a listing of EFH and further information, please go to our website at: www.nero.noaa.gov/hcd.

If you wish to discuss this further, please call 732-872-3023

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Habitat Conservation Division
James J. Howard Marine
Sciences Laboratory
74 Magruder Road
Highlands, New Jersey 07732

May 5, 2008

TO: Bethany Bearmore
NOAA Restoration Center
James J. Howard Marine Sciences Laboratory
74 Magruder Road
Highlands, New Jersey 07732

SUBJECT: Proposed Little Tinicum Island Trail and Habitat Enhancement
Delaware Co., PA

Karen Greene
(Reviewing Biologist)

We have reviewed the information provided to us regarding the above subject project. We offer the following preliminary comments pursuant to the Endangered Species Act, the Fish and Wildlife Coordination Act and the Magnuson-Stevens Fishery Conservation and Management Act:

Endangered Species Act

Threatened and endangered shortnose sturgeon may be present in the project area at certain times of the year. If any work is proposed below the mean high water line of the Delaware River, the lead federal action agency should contact NMFS Protected Resources Division to initiate coordination on this project. Requests for coordination can be addressed to: Ms. Julie Crocker of NOAA Fisheries Service's Protected Resources Division, One Blackburn Drive, Gloucester, MA 01930-2298.

Fish and Wildlife Coordination Act

The Delaware River provide valuable nursery and forage habitat for a number of species of concern to NMFS including anadromous fish such as striped bass, alewife, blueback herring and American shad. From the project description, it does not appear that the proposed project will have an adverse effect on these species. Wetlands fill should be avoided. Areas where walkways cross over wetlands should be minimized and limited in width to four feet, if possible. Height of walkways over wetlands should be at least 4.5 feet to minimize the effects of shading on wetlands vegetation.

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat

No EFH has been designated in the project area. An EFH consultation by the federal action agency will not be required as part of the permit process. Should project plans change that would modify the basis for this determination, or if new species or EFH is designated, consultation should be reinitiated. For a listing of EFH and further information, please go to our website at: www.nero.noaa.gov/hcd. If you wish to discuss this further, please call 732-872-3023

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Habitat Conservation Division
James J. Howard Marine
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74 Magruder Road
Highlands, New Jersey 07732

May 5, 2008

TO: Bethany Bearmore
NOAA Restoration Center
James J. Howard Marine Sciences Laboratory
74 Magruder Road
Highlands, New Jersey 07732

SUBJECT: Proposed Mad Horse Creek Restoration Site
Lower Alloway Creek Twp., Salem Co. NJ

Karen Greene
(Reviewing Biologist)

We have reviewed the information provided to us regarding the above subject project. We offer the following preliminary comments pursuant to the Endangered Species Act, the Fish and Wildlife Coordination Act and the Magnuson-Stevens Fishery Conservation and Management Act:

Endangered Species Act

No threatened or endangered species under the jurisdiction of the NMFS are known to occur in the project area. As a result, further consultation is not required. However should project plans change that would change the basis for determination, or if new species or critical habitat is designated, consultation should be reinitiated.

Fish and Wildlife Coordination Act

A wide variety of resources under NMFS jurisdiction occur within Mad Horse Creek including anadromous and resident fish, forage and benthic species such as alewife, blueback herring, striped bass, weakfish, white perch, bay anchovy, mummichog., and Atlantic croaker. Depending upon the in-water work proposed and the exact location of the restoration, we may recommend seasonal in-water work restrictions within Mad Horse Creek from 3/1 to 6/30 to reduce impacts to anadromous fish.

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat

The estuarine waters of Mad Horse Creek have been designated as Essential Fish Habitat (EFH) for one or more species. Restoration activities at the site may have minor temporary impacts of EFH and federally managed species. These can be minimized by using best management practices to protect water quality and reduce sediments entering the creek. The restoration of the site will benefit EFH. Because the impacts of the project are expected to be minor in nature and temporary, further EFH consultation will not be necessary required as part of the federal permit process. Should project plans change that would change the basis for determination, or if new species or EFH are designated, the federal action agency should reinitiate consultation. For a listing of EFH and further information, please go to our website at: http://www.nero.noaa.gov/hcd. If you wish to discuss this further, please call 732-872-3023.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Habitat Conservation Division
James J. Howard Marine
Sciences Laboratory
74 Magruder Road
Highlands, New Jersey 07732

May 5, 2008

TO: Bethany Bearmore
NOAA Restoration Center
James J. Howard Marine Sciences Laboratory
74 Magruder Road
Highlands, New Jersey 07732

SUBJECT: Oyster Reef Restoration in Delaware Bay

Karen Greene
(Reviewing Biologist)

We have reviewed the information provided to us regarding the above subject project. We offer the following preliminary comments pursuant to the Endangered Species Act, the Fish and Wildlife Coordination Act and the Magnuson-Stevens Fishery Conservation and Management Act:

Endangered Species Act

Several species of sea turtles are of each year including the threatened loggerhead (*Caretta caretta*), endangered Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*) and green (*Chelonia mydas*) sea turtles are present in Delaware Bay, mainly during the late spring, summer and early fall when water temperatures are relatively warm. Consultation pursuant to Section 7 of the Endangered Species Act may be necessary for the proposed oyster restoration activities. Please contact Ms. Julie Crocker of our Protected Resources Division at the following address for information on the Section 7 consultation needs for this project. NOAA Fisheries Service's Protected Resources Division, One Blackburn Drive, Gloucester, MA 01930-2298.

Fish and Wildlife Coordination Act

A wide variety of resources under NMFS jurisdiction occur within Mad Horse Creek including anadromous and resident fish, forage and benthic species such as alewife, blueback herring, striped bass, Atlantic sturgeon, winter flounder, summer flounder, windowpane, bluefish, horseshoe crabs, blue crabs, weakfish, bay anchovy, mummichog., and Atlantic croaker.

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat

The project area has been designated as Essential Fish Habitat (EFH) for one or more species. Based upon the nature of the work proposed, we do not anticipate significant adverse impacts to EFH. As a result, further EFH consultation will be not needed as part of the federal permit process. For a listing of EFH and further information, please go to our website at: http://www.nero.noaa.gov/hcd. If you wish to discuss this further, please call 732-872-3023.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Habitat Conservation Division
James J. Howard Marine
Sciences Laboratory
74 Magruder Road
Highlands, New Jersey 07732

May 5, 2008

TO: Bethany Bearmore
NOAA Restoration Center
James J. Howard Marine Sciences Laboratory
74 Magruder Road
Highlands, New Jersey 07732

SUBJECT: Stow Creek Boat Ramp
Stow Creek Twp., Cumberland Co. NJ

Karen Greene
(Reviewing Biologist)

We have reviewed the information provided to us regarding the above subject project. We offer the following preliminary comments pursuant to the Endangered Species Act, the Fish and Wildlife Coordination Act and the Magnuson-Stevens Fishery Conservation and Management Act:

Endangered Species Act

No threatened or endangered species under the jurisdiction of the NMFS are known to occur in the project area. As a result, further consultation is not required. However should project plans change that would change the basis for determination, or if new species or critical habitat is designated, consultation should be reinitiated.

Fish and Wildlife Coordination Act

A wide variety of resources under NMFS jurisdiction occur within Stow Creek including anadromous and resident fish, forage and benthic species such as alewife, blueback herring, striped bass, weakfish, white perch, bay anchovy and mummichog. Based upon the information provided, no more than a minimal, temporary impact are expected to occur and no seasonal work restrictions are necessary.

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat

The estuarine waters of Stow Creek have been designated as Essential Fish Habitat (EFH) for one or more species. Based upon the nature of the work proposed, we do not anticipate significant adverse impacts to EFH. As a result, further EFH consultation will be not needed as part of the federal permit process. Should project plans change that would change the basis for determination, or if new species or EFH are designated, the federal action agency should reinitiate consultation. For a listing of EFH and further information, please go to our website at: http://www.nero.noaa.gov/hcd. If you wish to discuss this further, please call 732-872-3023.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
OFFICE OF OCEAN AND COASTAL RESOURCE MANAGEMENT
Silver Spring, Maryland 20910

AUG 11 2008

Tom Brosnan
Northeast Branch Manager
NOAA Office of Response and Restoration
1305 East-West Highway, Station 10219 (N/ORR31)
Silver Spring, MD 20910

Dear Mr. Brosnan: Tom

This letter is in reference to the proposal for a restoration project at the Blackbird Reserve Wildlife Area designed to improve habitat for migratory geese. This approximately 535-acre property was acquired in part using a grant to the Delaware Coastal Program from NOAA's Coastal and Estuarine Land Conservation Program (CELCP), and is owned and managed by Delaware Department of Fish and Wildlife (DFW). Because agricultural activities are not allowed on CELCP-funded projects, as part of the grant agreement the State was to discontinue the agricultural uses of the property and undertake restoration of the agricultural area (152.9 acres) to habitat. The purpose of this letter is to address the issue of whether the restoration project, which involves agricultural activities, would be considered permissible or if it would violate the CELCP Guidelines, which is of concern to the Delaware Coastal Program.

It is our understanding that:

- The project would entail restoring 41.8 acres of the 152.9 acres to a combination of forested areas, wetland ponds, wildlife pasture, and "*wildlife food plots*."
- "Wildlife food plots" are in effect agricultural areas in that they are typically planted with crops (for this project, specifically corn, soybean or winter wheat) and managed using standard agricultural practices.
- The overall restoration plan and the specifics of this arrangement provide that in total, 23.6 of the 41.8 acres will be in use as "wildlife food plots" and that this amount of acreage is the minimum size necessary to adequately provide habitat and food for the number of migratory geese anticipated to use the property for such. The wildlife food plot use will affect less than 5 percent of the property's total acreage (23.6 is 4.4% of 535 acres).
- DFW will contract with a local farmer to plant and maintain the food plots. The farmer would be "paid" through an in-kind arrangement: the farmer will be allowed to harvest and sell up to 80% of the planted crops in return for managing the food plots. There is not intent for DFW to derive income from this arrangement.
- The remaining 20% of the standing crop and all crop residue would comprises the food and feeding habitat for the migratory geese.
- The agricultural activities required for this project will be conducted in accordance with (or exceed) the State's management measures to address the impacts of nonpoint source pollution from agricultural activities, as approved (by EPA and NOAA) as part of Delaware's Coastal Nonpoint Pollution Control Program.

Given this context, CELCP staff are prepared to find that this specific project would not violate our Guidelines. This finding is based on the assumptions that the agricultural activities necessary to accomplish this project are intended primarily for habitat management purposes and that any revenues generated are incidental to the restoration project (i.e., the agricultural activities are not intended to be primarily commercial in nature). It is also noted that the use would affect only a very small portion of the property.

This finding is specific to this project only, and should not be construed as a change to CELCP policy regarding agriculture. Comparable projects contemplated for other CELCP-funded projects in Delaware (or elsewhere) would have to be reviewed on their own merit.

Should the approach or other circumstances of this project change in the future, we would appreciate being notified and given the opportunity to review the revised project plan. If you have any questions, please contact me.

Sincerely,

Elisabeth Morgan
CELCP Manager

cc: David Carter, Delaware Coastal Program

Appendix 7. Consultation letters regarding Coastal Zone Management and the Endangered Species Act

Pennsylvania Department of Environmental Protection

Rachel Carson State Office Building
P.O. Box 2063
Harrisburg, PA 17105-2063
February 18, 2009

Water Planning Office 717-772-5622

Linda Burlington
NOAA Office of General Counsel for Natural Resources
GCNR
1315 East-West Highway, Bldg. 3
Silver Spring, MD 20910

Re: DEP File No. CZ7: FDP

Dear Ms. Burlington:

The Pennsylvania Coastal Resources Management (CRM) Program has reviewed the information received in this office on January 9, 2009 concerning the **Draft Restoration Plan Identifying Four Projects Located in Pennsylvania's Coastal Zone Resulting From the Athos I Oil Spill.** The plan includes: freshwater tidal wetlands restoration at John Heinz National Wildlife Refuge, dam removal and habitat restoration in Darby Creek, shoreline restoration at Lardner's Point, and enhancements to the recreational trail on Little Tinicum Island in the Greater Philadelphia Region, Pennsylvania.

Under 15 CFR Part 930 Subpart C -- Consistency for Federal Agency Activities, the projects in this Plan are subject to CRM's consistency review. We have determined that this aforementioned Plan is consistent with Pennsylvania's CRM Program.

Please note that this determination pertains only to the federal consistency review requirements under the Federal Coastal Zone Management Act of 1972, as amended, and does not constitute a waiver from further Department of Environmental Protection's review or other Departmental permits.

Sincerely,

Donovan J. Houck
Environmental Planner
Coastal Resources Management Program

Enclosure

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES & ENVIRONMENTAL CONTROL
DIVISION OF SOIL AND WATER CONSERVATION
89 KINGS HIGHWAY
DOVER, DELAWARE 19901

DELAWARE COASTAL
MANAGEMENT PROGRAM

TELEPHONE: (302) 739-928
FAX: (302) 739-204

March 11, 2009

Linda Burlington
NOAA Office of General Counsel for Natural Resources
GCNR
1315 East-West Highway, Bldg. 3
Silver Spring, Maryland 20910

RE: Delaware Coastal Zone Federal Consistency
Athos I Draft Damage Assessment and Restoration Plan (FC 09.033)

Dear Ms. Burlington:

The Delaware Coastal Management Program (DCMP) has received and reviewed your consistency determination request for the above referenced project. Based upon our review and pursuant to National Oceanic & Atmospheric Administration regulations (15 CFR 930), the DCMP concurs with your consistency determination for the Draft Damage Assessment and Restoration Plan and Environmental Assessment (DARP/EA) for the November 26, 2004, Athos I oil spill on the Delaware River.

Ten potential restoration projects are proposed, three of which are located in Delaware. The activities proposed for Delaware include 26 acres of oyster reef restoration in the Delaware Bay, breakwater installation to reduce shoaling and dredging frequency at the Augustine Creek boat ramp in New Castle County, and a pond, pasture and agricultural food plot project for migratory birds at the Blackbird Reserve Wildlife Area.

The Blackbird Reserve Wildlife Area property located in southern New Castle County, was acquired in part using a grant to Delaware Coastal Programs from NOAA's Coastal and Estuarine Land Conservation Program (CELCP). Consequently, certain property use restrictions apply, including limitations on proposed agricultural activities. It is our understanding that the agricultural food plots would not violate CELCP funding guidelines. A letter from CELCP Manager Elisabeth Morgan to Tom Brosnan, Northeast Branch Manager for NOAA Office of Response and Restoration, dated August 11, 2008 and included in Attachment 2 of the DARP/EA confirms that the project as proposed does not violate CELCP guidelines for agricultural activities.

If either of the three Delaware projects are selected as final restoration alternatives, the Delaware Coastal Programs would appreciate the opportunity to review and comment on the design details. Furthermore, please be advised that these activities may require review by this office to ensure compliance with federal consistency regulations pursuant to *15 CFR Part 930.*

If you have any questions please do not hesitate to contact me or Tricia Arndt at (302) 739-9283.

Sincerely,

Sarah W. Cooksey, Administrator
Delaware Coastal Management Program

SWC:tka
cc: File 09.033
Rob Hossler-DFW

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Division of Land Use Regulation
P.O. Box 439, Trenton, NJ 08625-0439
Fax # (609) 777-3656
www.state.nj.us/dep/landuse

JON S. CORZINE
Governor

MARK N. MAURIELLO
Acting Commissioner

Linda Burlington
NOAA, Office of general Counsel for Natural Resources
GCNR
1315 East-West Highway, Bldg. 3
Silver Spring, Maryland 20910

MAY 15 2009

RE: Draft Damage Assessment and Restoration Plan and Environmental Assessment for the *Athos I* Oil Spill
Federal Consistency Determination
Division of Land Use Regulation File No. 0000-09-0012.1 (CDT 090001)

Dear Ms. Burlington:

The New Jersey Department of Environmental Protection, Division of Land Use Regulation, acting under Section 307 of the Federal Coastal Zone Management Act (P.L. 92-583) as amended, has reviewed the information provided in conjunction with the Draft Damage Assessment and Restoration Plan and Environmental Assessment for the *Athos I* Oil Spill, January 2009. The Division has determined that the proposed projects are consistent with New Jersey's Rules on Coastal Zone Management N.J.A.C. 7:7E-1.1 et seq., (amended on April 07, 2008) and the applicable Rules guiding issuance of a Section 401 Water Quality Certificate.

Project Description

The draft restoration plan identifies ten preferred projects, three of which are within New Jersey. The National Oceanic and Atmospheric Administration (NOAA), U.S. Fish and Wildlife Service (USFWS), and the states of Delaware, Pennsylvania, and New Jersey, also known as the federal and state natural resource trustees (the "Trustees") have proposed oyster reef restoration, habitat restoration at Mad Horse Creek, and improvements to the Stow Creek boat ramp.

This consistency determination is issued subject to compliance with the following conditions.

1. All fill material used on site shall come from a suitable source and be clean and free of toxins.

2. All debris, wood, trash, and other loose materials shall be discarded and legally disposed of offsite. The applicant shall take special care that no debris enters or remains in the water.

3. Any temporary vegetation disturbance shall be replanted with indigenous, non-invasive vegetation.

4. The Trustees shall ensure that all best management practices identified are followed as appropriate.

5. The Trustees shall provide the Division for review and concurrence with copies of final design plans and guidelines.

Thank you for your attention to and cooperation with New Jersey's Coastal Zone Management Program. If you have any questions regarding this determination, please do not hesitate to call Christopher Dolphin of our staff at (609) 777-0454.

Sincerely,

R. Langbein

5/15/09

Richard Langbein
Manager
Bureau of Coastal Regulation

Date

c: NJDEP Enforcement
Kim Springer, Coastal Management Office

Adjudicatory Hearing Request Checklist and Tracking Form

I. **Permit Decision or Other Department Decision Being Appealed:**

_____

_____

Issuance Date of Decision Document — Document Number (If any)

II. **Please provide Name, Address and Phone No. of:**

Person Requesting Hearing	Name of Attorney (If applicable)
Address	Address
Phone No.	Phone No.

III. **If you are the applicant or permittee, please include the following information with your hearing request:**

A. The date you received the permit decision or other decision which you are appealing;
B. A copy of the decision document;
C. The findings of fact and conclusions of law you are appealing;
D. A statement as to whether or not you raised each legal and factual issue during the permit application process;
E. Suggested revised or alternative permit conditions;
F. An estimate of the time required for the hearing;
G. A request, if necessary, for a barrier-free hearing location for physically disabled persons;
H. A clear indication of any willingness to negotiate a settlement with the Department prior to the Department's processing of our hearing request to the Office of Administrative Law; and
I. This form completed; signed and dated with all of the information listed above, including attachment to:

1. New Jersey Department of Environmental Protection Office of Legal Affairs
   Attention: Adjudicatory Hearing Requests
   401 East State Street
   P.O. Box 402
   Trenton, NJ 08625-0402:

With a copy to:

2. New Jersey Department of Environmental Protection
   Land Use Regulation Program
   Attention: Director
   P.O. Box 439
   Trenton, NJ 08625-0439

Signature: _____ Date: _____

IV. **If you are a person other than the applicant or permittee, please include the following information with your hearing request:**

A. The date you or your agent received notice of the permit decision, and a copy of the permit decision;
B. Evidence that a copy of your hearing request has been delivered to the applicant for the permit decision which is the subject of your hearing request (e.g., certified mail return receipt);
C. A detailed statement of which findings of fact and/or conclusion of law you are challenging;
D. A description of our participation in any public hearings held in connection with the permit application and copies of any written comments you submitted;
E. Whether you claim a statutory or constitutional right to a hearing, and, if you claim such a right, a reference to the applicable statue or an explanation of how your interests are affected by the permit decision;
F. Suggested revised or alternative permit conditions;
G. An estimate of the time required for the hearing;
H. A request, if necessary, for a barrier-free hearing location for physically disabled persons;
I. A clear-indication of any willingness to negotiate a settlement with the Department prior to the Department's processing of the hearing request to the Office of Administrative Law; and
J. This form completed, signed and dated with all the information listed above, including attachments to

1. New Jersey Department of Environmental Protection Office of Legal Affairs
   Attention: Adjudicatory Hearing Requests
   401 East State Street
   P.O. Box 402
   Trenton, NJ 08625-0402:

With a copy to:

2. New Jersey Department of Environmental Protection
   Land Use Regulation Program
   Attention: Director
   P.O. Box 439
   Trenton, NJ 08625-0439

Signature: _____ Date: _____

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pennsylvania Field Office
315 South Allen Street, Suite 322
State College, Pennsylvania 16801-4850

January 26, 2009

Linda Burlington
NOAA Office of General Counsel for Natural Resources
GCNR
1315 East-West Highway, Bldg. 3
Silver Spring, MD 20910

RE: USFWS Project # FA-2009-0054

Dear Ms. Burlington:

This responds to your letters of January 6, 2009, requesting information about federally protected species within the area affected by four restoration projects identified in the Draft Damage Assessment and Restoration Plan and Environmental Assessment for the *Athos I* Oil Spill. The projects, located in Delaware and Philadelphia Counties, Pennsylvania, include: 1) trail restoration, removal of invasive plants, and construction of a bridge on Little Tinicum Island; 2) riparian habitat restoration at Lardner's Point; 3) tidal marsh restoration at the John Heinz National Wildlife Refuge; and 4) dam removal, and riparian restoration and enhancement along Darby Creek. The following comments are provided pursuant to the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*), and the Bald and Golden Eagle Protection Act (54 Stat. 250, as amended; 16 U.S.C. 668-668d).

Federally Listed Species

Except for occasional transient species, no federally listed or proposed, threatened or endangered species under our jurisdiction are known to occur within the project impact area. Therefore, based on currently available information, no biological assessment or further consultation under the Endangered Species Act is required with the Fish and Wildlife Service. Should project plans change, or if additional information on listed or proposed species becomes available, this determination may be reconsidered.

Please note that a field survey may reveal previously undocumented populations of one or more species of concern within a project area. Refer to the enclosed list of *Federally Listed, Proposed, and Candidate Species in Pennsylvania* to determine which species may be found in your project area if suitable habitat is present. If surveys or further information reveals that a federally listed, proposed, or candidate species exists in your project area, contact the Fish and Wildlife Service immediately to discuss measures to avoid or minimize potential impacts to the species prior to initiating your project.

Bald Eagle

The bald eagle has been removed from the federal *List of Endangered and Threatened Wildlife*, and is therefore no longer protected under the Endangered Species Act. However, it continues to be protected under the Bald and Golden Eagle Protection Act (Eagle Act) and the Migratory Bird Treaty Act (MBTA). Both acts protect bald eagles by prohibiting killing, selling or otherwise harming eagles, their nests or eggs. The Eagle Act also protects eagles from disturbance. "Disturb" means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle; 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior; or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.

On June 4, 2007, the Service released several important documents related to the protection of bald eagles under the Eagle Act, including 1) a final rule establishing a regulatory definition of "disturb"; 2) a final environmental assessment of the "disturb" regulation; 3) *National Bald Eagle Management Guidelines*; and 4) a proposed rule to establish a permit for the take of bald and golden eagles. The proposed rule would establish regulations for issuing permits to take bald and golden eagles where the take is associated with, and not the purpose of, otherwise lawful activities. A second permit type would provide for permits to take bald and golden eagle nests for safety emergencies (of humans or eagles). All of these documents can be found at http://www.fws.gov/migratorybirds/baldeagle.htm.

The projects are located in the known range of the bald eagle. Bald eagles typically occur in the vicinity of aquatic ecosystems; they frequent lakes, reservoirs, rivers such as the Delaware River, and wetland systems. Their nests are usually built in large trees within two miles of these features. Eagles are vulnerable to human disturbance, particularly during the nesting season. Because bald eagles are continuing to expand their breeding range in this region, new eagle nests may be found in previously undocumented locations in the project area. Please be aware of this possibility before beginning any construction. If a new nest is located, please contact this office for additional guidance.

Based on the scope of your projects and current known locations of eagle nests, these projects are not likely to disturb bald eagles. Because no take or disturbance is anticipated, none is authorized. If project plans change, please contact the Service to determine whether or not the project modifications will result in effects to bald eagles that may necessitate an Eagle Act permit.

The above determinations are valid for one year from the date of this letter. If a proposed project has not been fully implemented prior to this, please contact our office for an updated review of the project and the effects. Re-submittal of this letter along with your request may expedite our review of the project.

To avoid potential delays in reviewing your project, please use the above-referenced USFWS project tracking number in any future correspondence regarding this project.

If you have any questions regarding these comments, please contact Melinda Turner at 814-234-4090.

Sincerely,

David Densmore
Supervisor

Enclosure

MAMMALS			
Indiana bat	*Myotis sodalis*	E	Hibernacula: Armstrong, Beaver, Blair, Centre, Fayette, Huntingdon, Lawrence, Luzerne, Mifflin and Somerset Co. Maternity sites: Adams, Bedford, Berks, Blair, Greene, and York Counties. Potential winter habitat state-wide in caves or abandoned mines. Potential summer habitat state-wide in forests or wooded areas.
BIRDS			
Piping plover	*Charadrius melodus*	E	Designated critical habitat on Presque Isle (Erie Co.). Migratory. No nesting in PA since 1950s, but recent colonization attempts at Presque Isle
REPTILES			
Bog turtle	*Clemmys (Glyptemys) muhlenbergii*	T	Adams, Berks, Bucks, Carbon, Chester, Cumberland, Delaware, Lancaster, Lebanon, Lehigh, Monroe, Montgomery, Northampton, Schuylkill and York Co. *Historically found in Crawford, Mercer and*
Eastern massasauga rattlesnake	*Sistrurus catenatus catenatus*	C	Butler, Crawford, Mercer and Venango Co. *Historically found in Allegheny and Lawrence Co.*
MUSSELS			
Clubshell	*Pleurobema clava*	E	French Creek and Allegheny River (and some tributaries) in Armstrong, Clarion, Crawford, Erie, Forest, Mercer, Venango, and Warren Co.; Shenango River (Mercer and Crawford Co.) *Has not been found recently in 13 streams of historical occurrence in Butler, Beaver, Fayette, Greene, Indiana, Lawrence, and Westmoreland Co.*
Dwarf wedgemussel	*Alasmidonta heterodon*	E	Delaware River (Pike and Wayne Co.). *Has not been found recently in streams of historical occurrence in the Delaware River watershed (Bucks, Carbon, Chester, Philadelphia Co.) or Susquehanna River watershed (Lancaster Co.)*
Northern riffleshell	*Epioblasma torulosa rangiana*	E	French Creek and Allegheny River (and some tributaries) in Armstrong, Clarion, Crawford, Erie, Forest, Mercer, Venango, and Warren Co. *Has not been found recently in streams of historical occurrence, including: Shenango River (Lawrence Co.), Conewango Creek (Warren Co.)*

US Fish and Wildlife Service
315 South Allen Street, Suite 322, State College, Pennsylvania 16801

Common Name	Scientific Name	Status[1]	Distribution (Counties and/or Watersheds)
MUSSELS (continued)			
Rayed bean	*Villosa fabalis*	C	French Creek and Allegheny River (Armstrong, Clarion, Crawford, Erie, Forest, Mercer, Venango, Warren Co.); Cussewago Creek (Crawford Co.). *Has not been found recently in 5 streams of historical occurrence in Armstrong, Lawrence, Mercer and Warren Co.*
Sheepnose	*Plethobasus cyphyus*	C	Allegheny River (Forest and Venango Co.). *Has not been found recently in streams of historical occurrence, including: Allegheny River (Armstrong Co.), Beaver River (Lawrence Co.), Ohio River (Allegheny and Beaver Co.), and Monongahela River (Washington Co.)*
FISH			
Atlantic sturgeon[2]	*Acipenser oxyrinchus oxyrinchus*	C	Delaware River and other Atlantic coastal waters
Shortnose sturgeon[2]	*Acipenser brevirostrum*	E	Delaware River and other Atlantic coastal waters
PLANTS			
Northeastern bulrush	*Scirpus ancistrochaetus*	E	Adams, Bedford, Blair, Cambria, Carbon, Centre, Clinton, Columbia, Cumberland, Dauphin, Franklin, Fulton, Huntingdon, Lackawanna, Lehigh, Lycoming, Mifflin, Monroe, Perry, Snyder, Tioga, and Union Co. *Historically found in Northampton Co.*
Small-whorled pogonia	*Isotria medeoloides*	T	Centre, Chester and Venango Co. *Historically found in Berks, Greene, Monroe, Montgomery and Philadelphia Co.*

[1] E = Endangered; T = Threatened; P = Proposed for listing; C = Candidate
[2] Atlantic sturgeon and shortnose sturgeon are under the jurisdiction of the National Marine Fisheries Service

US Fish and Wildlife Service
315 South Allen Street, Suite 322, State College, Pennsylvania 16801

United States Department of the Interior

FISH AND WILDLIFE SERVICE

New Jersey Field Office
927 North Main Street, Building D
Pleasantville, New Jersey 08232
Tel: 609-646-9310 Fax: 609-646-0352
http://www.fws.gov/northeast/njfieldoffice

IN REPLY REFER TO:
09-I-0306

FEB 25 2009

Ms. Linda Burlington
NOAA Office of General Council for Natural Resources
GCNR
1315 East-West Highway, Bldg. 3
Silver Spring, Maryland 20910
Fax Number: (301) 713-1229

Reference: Mad Horse Creek restoration to address injuries from the *Athos I* Oil Spill
Lower Alloway Creek Township, Salem County, New Jersey

The U.S. Fish and Wildlife Service (Service) has reviewed the above-referenced proposed project pursuant to the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) (ESA) to ensure the protection of federally listed endangered and threatened species, and pursuant to the Bald and Golden Eagle Protection Act (54 Stat. 250; 16 U.S.C. 668-668d) (Eagle Act). The following comments do not address all Service concerns for fish and wildlife resources and do not preclude separate review and comment by the Service as afforded by other applicable environmental legislation. No federally listed or proposed threatened or endangered flora or fauna under Service jurisdiction are known to occur within the proposed project's impact area. Therefore, no further consultation pursuant the ESA is required. If additional information on federally listed species becomes available, or if project plans change, this determination may be reconsidered.

The following type(s) of bald eagle (*Haliaeetus leucocephalus*) habitat may occur in the project's impact area:

☒ nesting ☒ foraging ☐ wintering/communal roost

The bald eagle was removed from the federal List of Endangered and Threatened Wildlife effective August 8, 2007. The bald eagle continues to be protected under the federal Eagle Act and Migratory Bird Treaty Act (40 Stat. 755; 16 U.S.C. 703-712). The bald eagle also remains a State-listed species under the New Jersey Endangered and Nongame Species Conservation Act (N.J.S.A. 23:2A et seq.), which carries protections under the State land use regulation program. These federal and State laws prohibit take of bald eagles. For the continued protection of bald eagles, and to ensure compliance with federal and State laws, the Service recommends managing bald eagles in accordance with the National Bald Eagle Management Guidelines and all applicable State regulations. Links to State agencies and the Guidelines are available on this office's web site at http://www.fws.gov/northeast/njfieldoffice/Endangered.

Please also refer to our web site for further information including federally listed and candidate species lists, procedures for requesting ESA review, and contacts for obtaining information from the New Jersey Natural Heritage and Endangered and Nongame Species Programs regarding State-listed and other species of concern.

Reviewing Biologist: Wendy Walsh
Wendy Walsh

Authorizing Supervisor: Annette Scherer
Annette Scherer, Team Leader
Endangered Species Program

eagle.doc 01/07/08

United States Department of the Interior

FISH AND WILDLIFE SERVICE

New Jersey Field Office
927 North Main Street, Building D
Pleasantville, New Jersey 08232
Tel: 609-646-9310 Fax: 609-646-0352
http://www.fws.gov/northeast/njfieldoffice

IN REPLY REFER TO:
09-I-0307

JUN 25 2009

Linda Burlington
NOAA Office of General Counsel for Natural Resources, GCNR
1315 East-West Highway, Bldg. 3
Silver Spring, Maryland 20910
Fax Number: (301) 713-1229
cc: Mary Andrews, NOAA Restoration
Fax Number: (410) 262-5666

Reference: Delaware River/Bay Oyster restoration to address injuries from the *Athos I* Oil Spill Cumberland and Cape May Counties, New Jersey

The U.S. Fish and Wildlife Service (Service) has reviewed the above-referenced proposed project pursuant to the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) (ESA) to ensure the protection of federally listed endangered and threatened species. The following comments do not address all Service concerns for fish and wildlife resources and do not preclude separate review and comment by the Service as afforded by other applicable environmental legislation.

A known occurrence or potential habitat for the following federally listed or candidate species is located on or near the project's impact area. However, the Service concurs that the proposed project is not likely to adversely affect federally listed or candidate species for the reasons listed below.

Species	Basis for Determination
red knot (*Calidris canutus rufa*), candidate	As discussed by conference call on June 22, 2009, the project will be implemented with a seasonal restriction on shell placement in the High Recruitment Zone from May 1 to June 15 to avoid disturbance of foraging birds during the spring migration season.

Except for the above-mentioned species, no other federally listed or proposed threatened or endangered flora or fauna under Service jurisdiction are known to occur within the proposed project's impact area. Therefore, no further consultation pursuant to the ESA is required. If additional information on federally listed species becomes available, or if project plans change, this determination may be reconsidered.

Please refer to this office's web site at http://www.fws.gov/northeast/njfieldoffice/Endangered/ for further information including federally listed and candidate species lists, procedures for requesting ESA review, the National Bald Eagle Management Guidelines, and contacts for obtaining information from the New Jersey Natural Heritage and Endangered and Nongame Species Programs regarding State-listed and other species of concern.

Reviewing Biologist: Wendy Walsh
Wendy Walsh

Authorizing Supervisor: Ron Popowski
Ron Popowski

nltaa.doc 06/02/2009

United States Department of the Interior

FISH AND WILDLIFE SERVICE

New Jersey Field Office
927 North Main Street, Building D
Pleasantville, New Jersey 08232
Tel: 609-646-9310 Fax: 609-646-0352
http://www.fws.gov/northeast/njfieldoffice

IN REPLY REFER TO:
09-I-0308

JAN 15 2009

Linda Burlington, Office of General Council for Natural Resources
National Oceanic and Atmospheric Administration
1315 East-West Highway, Bldg. 3
Silver Spring, Maryland 20910
Fax Number: (301) 713-1229

Reference: Stow Creek Boat Ramp improvements to address injuries from the *Athos I* Oil Spill
Stow Creek Township, Cumberland County, New Jersey

The U.S. Fish and Wildlife Service (Service) has reviewed the above-referenced proposed project pursuant to the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) (ESA) to ensure the protection of federally listed endangered and threatened species, and pursuant to the Bald and Golden Eagle Protection Act (54 Stat. 250; 16 U.S.C. 668-668d) (Eagle Act). The following comments do not address all Service concerns for fish and wildlife resources and do not preclude separate review and comment by the Service as afforded by other applicable environmental legislation. No federally listed or proposed threatened or endangered flora or fauna under Service jurisdiction are known to occur within the proposed project's impact area. Therefore, no further consultation pursuant the ESA is required. If additional information on federally listed species becomes available, or if project plans change, this determination may be reconsidered.

The following type(s) of bald eagle (*Haliaeetus leucocephalus*) habitat may occur in the project's impact area:

☐ nesting ☑ foraging ☐ wintering/communal roost

The bald eagle was removed from the federal List of Endangered and Threatened Wildlife effective August 8, 2007. The bald eagle continues to be protected under the federal Eagle Act and Migratory Bird Treaty Act (40 Stat. 755; 16 U.S.C. 703-712). The bald eagle also remains a State-listed species under the New Jersey Endangered and Nongame Species Conservation Act (N.J.S.A. 23:2A et seq.), which carries protections under the State land use regulation program. These federal and State laws prohibit take of bald eagles. For the continued protection of bald eagles, and to ensure compliance with federal and State laws, the Service recommends managing bald eagles in accordance with the National Bald Eagle Management Guidelines and all applicable State regulations. Links to State agencies and the Guidelines are available on this office's web site at http://www.fws.gov/northeast/njfieldoffice/Endangered.

Please also refer to our web site for further information including federally listed and candidate species lists, procedures for requesting ESA review, and contacts for obtaining information from the New Jersey Natural Heritage and Endangered and Nongame Species Programs regarding State-listed and other species of concern.

Reviewing Biologist: Wendy Walsh
Wendy Walsh

Authorizing Supervisor: Annette Scherer 1/15/09
Annette Scherer, Team Leader
Endangered Species Program

eagle.doc 01/07/08

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, MD 21401
410/573-4575

January 23, 2009

Linda Burlington
NOAA Office of General Counsel for Natural Resources
GCNR
1315 East-West Highway, BLDG 3
Silver Spring, MD 20910

RE: Augustine Beach on Delaware River New Castle, De

Dear Ms. Burlington;

This responds to your letter, received January 6, 2009, requesting information on the presence of species which are federally listed or proposed for listing as endangered or threatened within the above referenced project area. We have reviewed the information you enclosed and are providing comments in accordance with section 7 of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.).

Except for occasional transient individuals, no proposed or federally listed endangered or threatened species are known to exist within the project impact area. Therefore, no Biological Assessment or further Section 7 Consultation with the U.S. Fish and Wildlife Service is required. Should project plans change, or if additional information on the distribution of listed or proposed species becomes available, this determination may be reconsidered.

This response relates only to federally protected threatened or endangered species under our jurisdiction. For information on the presence of other rare species, you should contact Edna Stetzar, of the Delaware Natural Heritage and Endangered Species Program, at (302) 653-2883 ext. 126. You may also obtain information on how to make such a request by visiting the Program website at www.dnrec.state.de.us/nhp.

Effective August 8, 2007, under the authority of the Endangered Species Act of 1973, as amended, the U.S. Fish and Wildlife Service (Service) removed (delist) the bald eagle in the lower 48 States of the United States from the Federal List of Endangered and Threatened Wildlife. However, the bald eagle will still be protected by the Bald and Golden Eagle Protection Act, Lacey Act and the Migratory Bird Treaty Act. As a result, starting on August 8, 2007, if your project may cause "disturbance" to the bald eagle, please consult the "National Bald Eagle Management Guidelines" dated May 2007.
If any planned or ongoing activities cannot be conducted in compliance with the National Bald Eagle Management Guidelines (Eagle Management Guidelines), please contact the Chesapeake Bay Ecological Services Field Office at 410-573-4573 for technical assistance. The Eagle

Management Guidelines can be found at:
http://www.fws.gov/migratorybirds/issues/BaldEagle/NationalBaldEagleManagementGuidelines.pdf.

In the future, if your project can not avoid disturbance to the bald eagle by complying with the Eagle Management Guidelines, you will be able to apply for a permit that authorizes the take of bald and golden eagles under the Bald and Golden Eagle Protection Act, generally where the take to be authorized is associated with otherwise lawful activities. This proposed permit process will not be available until the Service issues a final rule for the issuance of these take permits under the Bald and Golden Eagle Protection Act.

An additional concern of the Service is wetlands protection. The Service's wetlands policy has the interim goal of no overall net loss of Delaware Bay's remaining wetlands, and the long term goal of increasing the quality and quantity of the Basin's wetlands resource base. Because of this policy and the functions and values wetlands perform, the Service recommends avoiding wetland impacts. All wetlands within the project area should be identified, and if construction in wetlands proposed, the U.S. Army Corps of Engineers, Philadelphia District should be contacted for permit requirements. They can be reached at (215) 656-6728.

We appreciate the opportunity to provide information relative to fish and wildlife issues, and thank you for your interest in these resources. If you have any questions or need further assistance, please contact Devin Ray at (410) 573-4531.

Sincerely,

Leopoldo Miranda Castro
Field Supervisor

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, MD 21401
410/573-4575

January 23, 2009

Linda Burlington
NOAA Office of General Counsel for Natural Resources
GCNR
1315 East-West Highway, BLDG 3
Silver Spring, MD 20910

RE: Oyster bed on New Castle, De

Dear Ms. Burlington;

This responds to your letter, received January 6, 2009, requesting information on the presence of species which are federally listed or proposed for listing as endangered or threatened within the above referenced project area. We have reviewed the information you enclosed and are providing comments in accordance with section 7 of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.).

Except for occasional transient individuals, no proposed or federally listed endangered or threatened species are known to exist within the project impact area. Therefore, no Biological Assessment or further Section 7 Consultation with the U.S. Fish and Wildlife Service is required. Should project plans change, or if additional information on the distribution of listed or proposed species becomes available, this determination may be reconsidered.

This response relates only to federally protected threatened or endangered species under our jurisdiction. For information on the presence of other rare species, you should contact Edna Stetzar, of the Delaware Natural Heritage and Endangered Species Program, at (302) 653-2883 ext. 126. You may also obtain information on how to make such a request by visiting the Program website at www.dnrec.state.de.us/nhp.

Effective August 8, 2007, under the authority of the Endangered Species Act of 1973, as amended, the U.S. Fish and Wildlife Service (Service) removed (delist) the bald eagle in the lower 48 States of the United States from the Federal List of Endangered and Threatened Wildlife. However, the bald eagle will still be protected by the Bald and Golden Eagle Protection Act, Lacey Act and the Migratory Bird Treaty Act. As a result, starting on August 8, 2007, if your project may cause "disturbance" to the bald eagle, please consult the "National Bald Eagle Management Guidelines" dated May 2007.
If any planned or ongoing activities cannot be conducted in compliance with the National Bald Eagle Management Guidelines (Eagle Management Guidelines), please contact the Chesapeake Bay Ecological Services Field Office at 410-573-4573 for technical assistance. The Eagle

Management Guidelines can be found at:
http://www.fws.gov/migratorybirds/issues/BaldEagle/NationalBaldEagleManagementGuidelines.pdf.

In the future, if your project can not avoid disturbance to the bald eagle by complying with the Eagle Management Guidelines, you will be able to apply for a permit that authorizes the take of bald and golden eagles under the Bald and Golden Eagle Protection Act, generally where the take to be authorized is associated with otherwise lawful activities. This proposed permit process will not be available until the Service issues a final rule for the issuance of these take permits under the Bald and Golden Eagle Protection Act.

An additional concern of the Service is wetlands protection. The Service's wetlands policy has the interim goal of no overall net loss of Delaware Bay's remaining wetlands, and the long term goal of increasing the quality and quantity of the Basin's wetlands resource base. Because of this policy and the functions and values wetlands perform, the Service recommends avoiding wetland impacts. All wetlands within the project area should be identified, and if construction in wetlands proposed, the U.S. Army Corps of Engineers, Philadelphia District should be contacted for permit requirements. They can be reached at (215) 656-6728.

We appreciate the opportunity to provide information relative to fish and wildlife issues, and thank you for your interest in these resources. If you have any questions or need further assistance, please contact Devin Ray at (410) 573-4531.

Sincerely,

Leopoldo Miranda Castro
Field Supervisor

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, MD 21401
410/573-4575

January 23, 2009

Linda Burlington
NOAA Office of General Counsel for Natural Resources
GCNR
1315 East-West Highway, BLDG 3
Silver Spring, MD 20910

RE: Blackbird Reserve Wildlife Area New Castle, De

Dear Ms. Burlington;

This responds to your letter, received January 6, 2009, requesting information on the presence of species which are federally listed or proposed for listing as endangered or threatened within the above referenced project area. We have reviewed the information you enclosed and are providing comments in accordance with section 7 of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*).

The federally threatened bog turtle *(Clemmys muhlenbergii)* may be present within the project area. Bog turtles primarily inhabit palustrine wetlands comprised of a muddy bottom or shallow water, and tussocks of vegetation. A survey for bog turtle habitat and bog turtles may be appropriate. These surveys should be conducted at any location the Delaware Natural Heritage and Endangered Species recommends. Upon completion, survey reports should be forwarded to both the Service and the Delaware Natural Heritage and Endangered Species Program for review. If you have not already sent a copy of your request for threatened and endangered species information to the Delaware Natural Heritage and Endangered Species Program please do so. Ms. Holly Niederriter can provide further details regarding the distribution of bog turtles in the state of Delaware, appropriate survey techniques for determining the presence of the species, and a list of qualified bog turtle surveyors. Ms. Niederriter may be contacted at (302) 653-2880 ext 121.

Except for occasional transient individuals, no other federally proposed or listed threatened or endangered species are known to exist within the project area. Should project plans change, or if additional information on the distribution of listed or proposed species becomes available this determination may be reconsidered.

This response relates only to federally protected threatened or endangered species under our jurisdiction. For information on the presence of other rare species, you should contact Edna

Stetzar of the Delaware Natural Heritage and Endangered Species Program at (302) 653-2883 ext. 126. You may also obtain information on how to make such a request by visiting the Program website at www.dnrec.state.de.us/nhp.

Effective August 8, 2007, under the authority of the Endangered Species Act of 1973, as amended, the U.S. Fish and Wildlife Service (Service) removed (delist) the bald eagle in the lower 48 States of the United States from the Federal List of Endangered and Threatened Wildlife. However, the bald eagle will still be protected by the Bald and Golden Eagle Protection Act, Lacey Act and the Migratory Bird Treaty Act. As a result, starting on August 8, 2007, if your project may cause "disturbance" to the bald eagle, please consult the "National Bald Eagle Management Guidelines" dated May 2007.

If any planned or ongoing activities cannot be conducted in compliance with the National Bald Eagle Management Guidelines (Eagle Management Guidelines), please contact the Chesapeake Bay Ecological Services Field Office at 410-573-4573 for technical assistance. The Eagle Management Guidelines can be found at: **http://www.fws.gov/migratorybirds/issues/BaldEagle/NationalBaldEagleManagementGuidelines.pdf.**

In the future, if your project can not avoid disturbance to the bald eagle by complying with the Eagle Management Guidelines, you will be able to apply for a permit that authorizes the take of bald and golden eagles under the Bald and Golden Eagle Protection Act, generally where the take to be authorized is associated with otherwise lawful activities. This proposed permit process will not be available until the Service issues a final rule for the issuance of these take permits under the Bald and Golden Eagle Protection Act.

An additional concern of the Service is wetlands protection. Federal and state partners of the Chesapeake Bay Program have adopted an interim goal of no overall net loss of the Basin's remaining wetlands, and the long term goal of increasing the quality and quantity of the Basin's wetlands resource base. Because of this policy and the functions and values wetlands perform, the Service recommends avoiding wetland impacts. All wetlands within the project area should be identified, and if construction in wetlands is proposed, the U.S. Army Corps of Engineers, Baltimore District, should be contacted for permit requirements. They can be reached at (410) 962-3670.

We appreciate the opportunity to provide information relative to fish and wildlife issues, and thank you for your interest in these resources. If you have any questions or need further assistance, please contact Andy Moser at (410) 573-4537.

Sincerely,

Leopoldo Miranda Castro
Field Supervisor